INDEX NUMBER COPYRIGHT DEPOSIT

Vol. 15 JUNE, 1944 No. 6

SURGERY

A Monthly Journal Devoted to the Art and Science of Surgery

EDITORS

ALTON OCHSNER, New Orleans OWEN H. WANGENSTEEN, Minneapolis

ASSOCIATE EDITOR

ALFRED BLALOCK, Baltimore

THE LIBRARY OF CONGRESS SERIAL RECORD

JUL 19 1944

CONTENTS

Original Communications

Observations on Battle Fractures of the Extremities. Major Oscar P. Hampton, Jr., Medical Corps, and Captain Joe M. Parker, Medical Corps, U. S. Army 869
Fractures of the Femur. Ralph K. Ghormley, M.D., George S. Phalen, M.D., Robert E. VanDemark, M.D., and Clarence A. Luckey, M.D., Rochester, Minn. 887
Traumatic Synostosis of the Distal Third of the Radius and Ulna. Captain Floyd Hurt and Captain Spencer C. Flo, Medical Corps, U. S. Army 894
Studies on Burns. I. The Effect of Plaster Confinement Applied at Varying Intervals After Burning. E. Meredith Alrich, M.S., M.D., and Edwin P. Lehman, M.D., Charlottesville, Va. 899
Studies on Burns. II. Observations on a Vasoconstrictor Substance in Lymph From a Burned Area. E. Meredith Alrich, M.S., M.D., Charlottesville, Va. 908
Cotton as a Suture Material. Earl O. Latimer, M.S., M.D., F.A.C.S., Chicago, Ill. 913
The Surgical Treatment of Carcinoma of the Common Bile Duct. Kenneth L. Pickrell, M.D., and Alfred Blalock, M.D., Baltimore, Md. 923
Gynecomastia. Major Elmer F. Gooel, Medical Corps, Army of the United States 938
Carcinoma of the Breast. Francis X. Paletta, M.D., and Edwin P. Lehman, M.D., Charlottesville, Va. 944
Experimental Esophagectomy. Orvar Swenson, M.D., Boston, Mass., and Lieutenant Thomas V. Magruder, Jr., Medical Corps, U. S. Army 954
Congenital Macrogingivae (Fibromatosis Gingivae) and Hypertrichosis. Louis T. Byars, M.D., F.A.C.S., and Bernard G. Sarnat, M.D., St. Louis, Mo. 964
Urinary Infection After Colostomy. H. Milwidsky, M.D., and F. Mandl, M.D., Jerusalem, Palestine 971
Rectal and Colonic Complications of Pelvic Irradiation. Herbert I. Kallet, M.D., F.A.C.S., and M. Jordan Thorstad, M.D., Detroit, Mich. 980
Report of Case of Retroperitoneal Hemangioendothelioma. T. J. Snodgrass, M.D., Janesville, Wis. 988
Foreign Body in the Thyroid Gland. Herbert T. Wikle, M.D., and Thomas Spellman, M.D., Brooklyn, N. Y. 994

Recent Advances in Surgery

A Discussion of the Acute Conditions Arising in Patients With Lymphogranuloma Venereum. William P. Longmire, Jr., M.D., Baltimore, Md. 997
Battle Front Surgery 1017
The Samuel D. Gross Prize 1018
Book Reviews 1019
Books Received 1021
Index 1023

Published by THE C. V. MOSBY COMPANY, St. Louis, U. S. A.

Copyright 1944 by The C. V. Mosby Company

JUL 17 1944

SURGERY

ADVISORY COUNCIL

DONALD C. BALFOUR, Rochester, Minn.
VILRAY P. BLAIR, St. Louis
BARNEY BROOKS, Nashville
ELLIOTT C. CUTLER, Boston
WILLIAM E. GALLIE, Toronto
EVARTS A. GRAHAM, St. Louis
HOWARD C. NAFFZIGER, San Francisco
HARVEY B. STONE, Baltimore
ALLEN O. WHIPPLE, New York City

EDITORIAL BOARD

FREDERICK A. COLLER, Ann Arbor
EDWARD D. CHURCHILL, Boston
VERNON C. DAVID, Chicago
LESTER R. DRAGSTEDT, Chicago
RALPH K. GHORMLEY, Rochester, Minn.
ROSCOE R. GRAHAM, Toronto
SAMUEL C. HARVEY, New Haven
FRANK HINMAN, San Francisco
EMILE F. HOLMAN, San Francisco
EDWIN P. LEHMAN, University, Va.
FRANK L. MELENEY, New York City
JOHN J. MORTON, Rochester, N. Y.
THOMAS G. ORR, Kansas City, Kan.
GEORGE T. PACK, New York City
WILDER G. PENFIELD, Montreal
ISIDOR S. RAVDIN, Philadelphia
WILLIAM F. RIENHOFF, JR., Baltimore

COMMITTEE ON PUBLICATIONS

ARTHUR W. ALLEN
Boston, Mass.

CLAUDE S. BECK
Cleveland, Ohio.

ELEXIOUS T. BELL
Minneapolis, Minn.

ISAAC A. BIGGER
Richmond, Va.

ALBERT C. BRODERS
Rochester, Minn.

J. BARRETT BROWN
St. Louis, Mo.

ALEXANDER BRUNSCHWIG
Chicago, Ill.

LOUIS A. BUIE
Rochester, Minn.

WARREN H. COLE
Chicago, Ill.

C. D. CREEVY
Minneapolis, Minn.

GEORGE M. CURTIS
Columbus, Ohio

M. DE BAKEY
New Orleans, La.

JOHN STAIGE DAVIS
Baltimore, Md.

WILLIAM J. DIECKMANN
Chicago, Ill.

DANIEL C. ELKIN
Atlanta, Ga.

WILLIS D. GATCH
Indianapolis, Ind.

CHARLES F. GESCHICKTER
Baltimore, Md.

J. SHELTON HORSLEY
Richmond, Va.

J. MASON HUNDLEY, JR.
Baltimore, Md.

ANDREW C. IVY
Chicago, Ill.

DENNIS E. JACKSON
Cincinnati, Ohio

J. ALBERT KEY
St. Louis, Mo.

CHAUNCEY LEAKE
San Francisco, Calif.

FRANCIS E. LEJEUNE
New Orleans, La.

HAROLD I. LILLIE
Rochester, Minn.

JOHN S. LUNDY
Rochester, Minn.

FRANK C. MANN
Rochester, Minn.

CHARLES W. MAYO
Rochester, Minn.

ROBERT L. PAYNE
Norfolk, Va.

LEO G. RIGLER
Minneapolis, Minn.

ERNEST SACHS
St. Louis, Mo.

ARTHUR M. SHIPLEY
Baltimore, Md.

ALBERT O. SINGLETON
Galveston, Texas

MAURICE B. VISSCHER
Minneapolis, Minn.

RALPH M. WATERS
Madison, Wis.

JAMES C. WHITE
Boston, Mass.

PHILIP D. WILSON
New York, N. Y.

JOHN A. WOLFER
Chicago, Ill.

Vol. 15, No. 6, June, 1944. Surgery is published monthly by The C. V. Mosby Company, 3523 Pine Blvd., St. Louis 3, Mo. Subscription price: United States, its possessions, Pan-American Countries, $10.00 a year; Canada, $11.50 (Canadian Currency); Foreign, $11.00. Entered as Second-Class Matter January 20, 1937, at the Post Office at St. Louis, Missouri, under the Act of March 3, 1879. Printed in U. S. A.

STAINLESS STEEL . . .

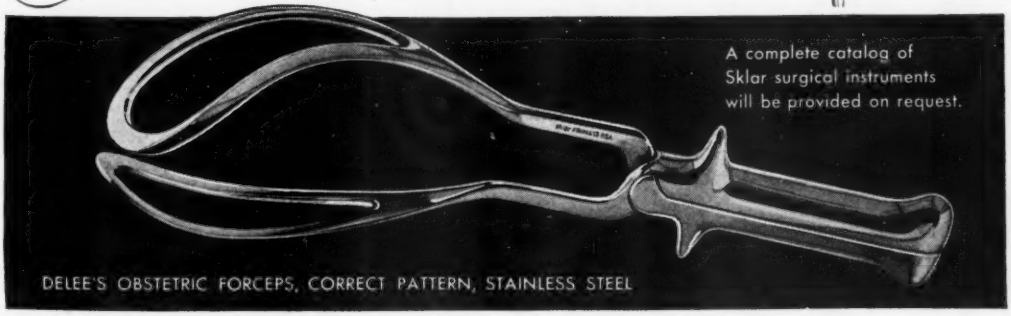
one of the century's most significant industrial innovations. Solved the corrosion problem . . . brought a new kind of steel combining high tensile strength with exceptionally high ductility . . . provided greater resistance to heat . . . lighter weight . . . and a clean, thoroughly polished surface such as industry was looking for!

Perfection IN ITS FIELD

TODAY, certain grades of stainless steel are considered by many metallurgists as ideal for certain manufacturing purposes. Through new combinations of alloys . . . more intensive study of steel structure . . . research is constantly increasing the industrial usefulness of this marvelous product. Pioneers in the adoption of many industrial innovations, the J. Sklar Manufacturing Company was among the first to use stainless steel in the making of surgical instruments. Quality materials . . . quality workmanship . . . half a century of "know how" . . . that's why the name SKLAR is synonymous with surgical instruments that are tough, resilient, durable, dependable . . . why SKLAR is first choice of the profession.

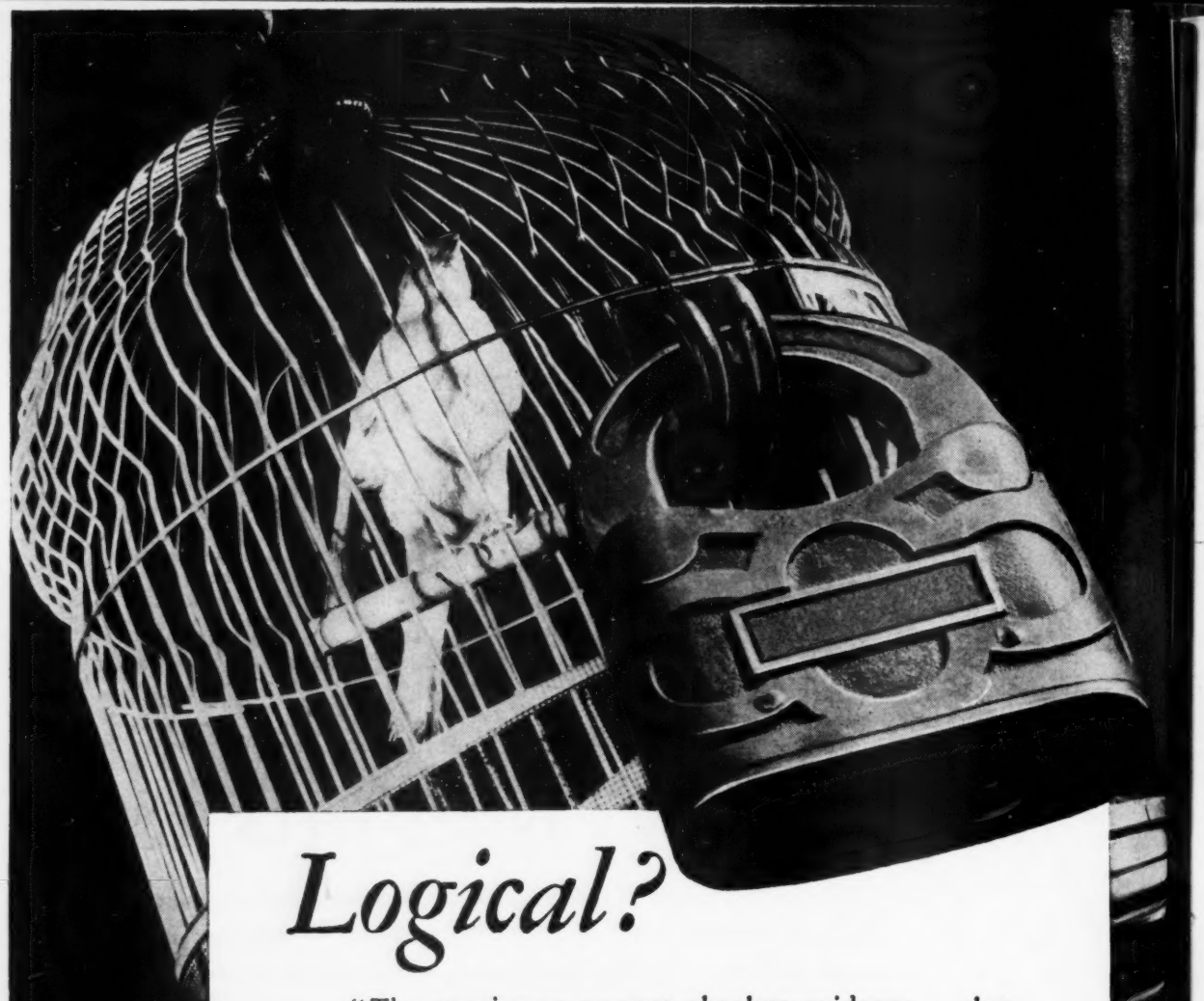
Sold only through accredited surgical instrument dealers.

Sklar LONG ISLAND CITY, N. Y.



A complete catalog of Sklar surgical instruments will be provided on request.

DELEE'S OBSTETRIC FORCEPS, CORRECT PATTERN, STAINLESS STEEL



Logical?

"The specimens present absolute evidence . . . that 5-0 chromic catgut retains its integrity in the tissues longer than larger sizes."*

This—and other characteristics which enable D & G Fine-Gauge Catgut to perform every function of conventional sizes with less trauma and tissue reaction—has made it the suture of choice for a wide range of procedures.

D&G Fine-Gauge Catgut

THE EVIDENCE—Comprehensive literature on the size of catgut in relation to wound healing will be submitted at your request.

* Bower, John O. et al.: *American Journal of Surgery*, 47:20, 1940.

DAVIS & GECK, INC. ARMY NAVY **57 WILLOUGHBY ST., BROOKLYN 1, N. Y.**

D & G sutures are obtainable through responsible dealers everywhere

Consistently proving their

SUPERIORITY . . .

RIB-BACK BLADES

feature undeviating qualities that facilitate the more successful attainment of the surgical objective

IN COMBINATION, the distinctive features which characterize these widely preferred surgical blades afford the optimum in cutting efficiency. They provide superior sharpness with uniformity. Greater strength is attained by the exclusive application of the Rib principle of blade reinforcement. All are qualities which contribute to long periods of satisfactory service and virtually eliminate the element of distractive influence.

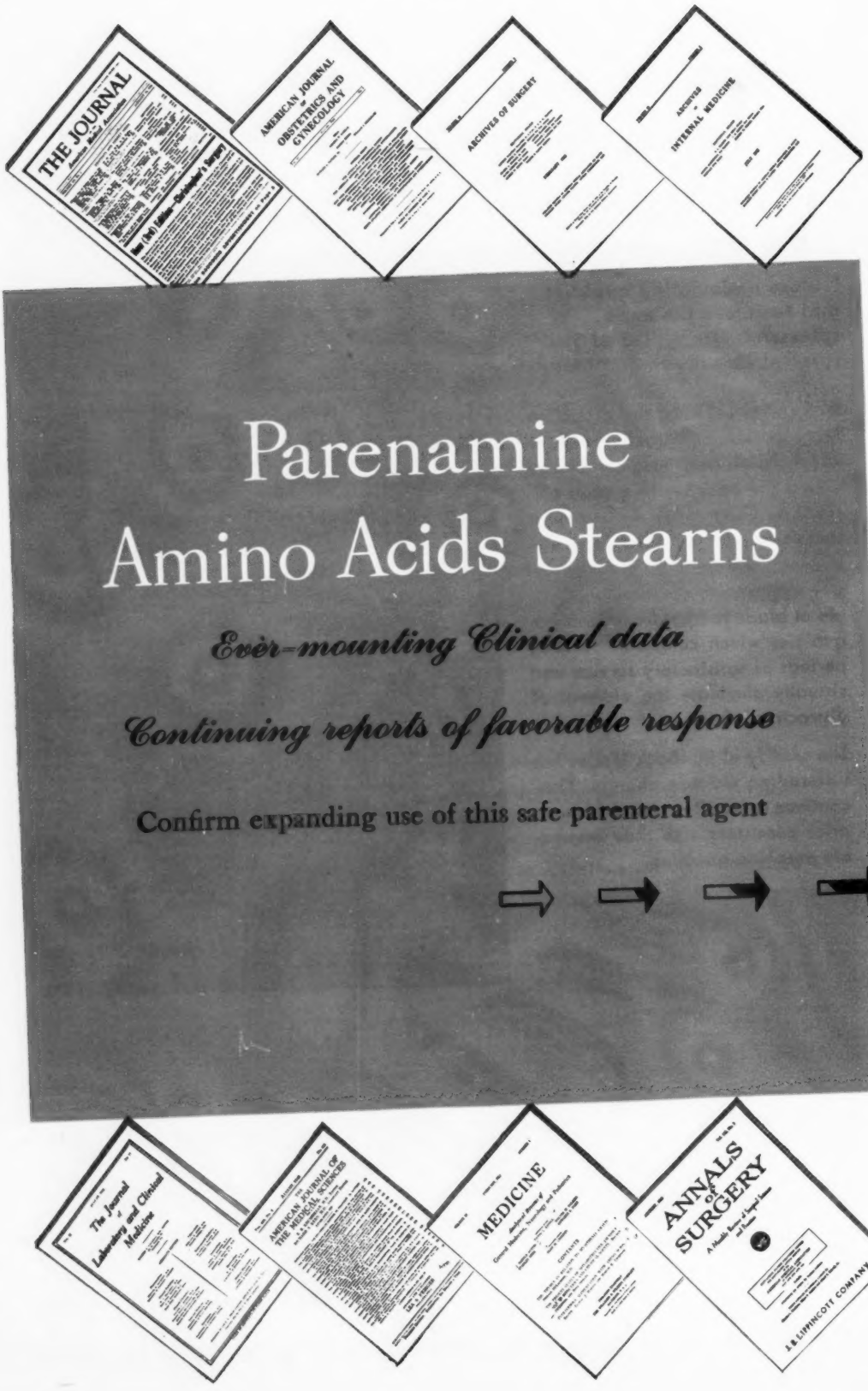
The quality of Rib-Back Blades has suffered no wartime change. They continue to be offered at the lowest price consistent with their inimitable precision qualities.

Ask your dealer

BARD-PARKER COMPANY, INC.

Danbury, Connecticut

A BARD-PARKER PRODUCT


THE JOURNAL
AMERICAN JOURNAL OF OBSTETRICS AND GYNECOLOGY
ARCHIVES OF SURGERY
ARCHIVES OF INTERNAL MEDICINE
Parenamine
Amino Acids Stearns
Ever-mounting Clinical data
Continuing reports of favorable response
Confirm expanding use of this safe parenteral agent
The Journal of Laboratory and Clinical Medicine
AMERICAN JOURNAL OF THE MEDICAL SCIENCES
MEDICINE
ANNALS OF SURGERY
J. B. LIPPINCOTT COMPANY

REPORTS ON SUCCESSFUL CLINICAL EXPERIENCES

Articles in recent issues of the medical press reveal the profession's growing appreciation of the value of Amino Acids as a therapeutic agent in the field of protein inadequacy. These continuing reports of favorable reaction and the ever-mounting data on successful clinical experience are responsible for the medical profession's rapidly increasing response to protein-nitrogen therapy and the expanding use of Amino Acids for the restoration of nitrogen balance.

Recognition of the importance of Parenamine (Amino Acids Stearns) in combating protein malnutrition has enabled us, in spite of difficult current conditions, to expand our production facilities sufficiently to meet this rapidly growing demand.

Corrects dietary protein deficiency to restore adequate nitrogen balance

To speed the healing of burns and wounds—to shorten days of convalescence after surgery—to check weight loss in wasting diseases—to assure adequate nitrogen balance wherever dietary protein intake is reduced . . .

These are some of the major functions of Parenamine (Amino Acids Stearns) which provides a reliable intravenous therapeusis where patients are unable to tolerate a high protein intake of food or are unable to take nourishment by mouth.

Parenamine may be administered parenterally or orally according to the severity of the condition.

Available for parenteral and oral administration as a 15% solution in 100 cc. rubber-capped vials. Details of therapy on request.
Trade Mark Parenamine
Reg. U. S. Pat. Office

Used post-operatively, Parenamine (Amino Acids Stearns) is finding rapidly increasing acceptance to prevent the development of hypoproteinemia and to correct protein deficiencies resulting from the operation.

Stearns Medical Division, through several years of intensive research, has accumulated a large fund of factual data and compiled an extensive bibliography. Correspondence is invited.

Frederick Stearns & Company

DETROIT 31, MICHIGAN

NEW YORK KANSAS CITY SAN FRANCISCO WINDSOR, ONTARIO SYDNEY, AUSTRALIA AUCKLAND, NEW ZEALAND

★ ★

IODINE

...a versatile germicide

★ Iodine is outstanding in its usefulness and efficiency as a germicide.

It is relied upon for pre-operative skin disinfection and for wound therapy. It is of service in the treatment of skin infections and parasitic skin diseases due to fungi. It has great value in the sterilization of cuts, bruises and abrasions.

The value of Iodine as an antiseptic is increased by the clinically demonstrated fact that it is bactericidal in concentrations which are not toxic to the tissues.

IODINE
Foe of Infection

Iodine Educational Bureau, Inc.
120 Broadway, New York 5, N. Y.

★ ★

The Journal of Bone and Joint Surgery

The Official Publication of the
American Orthopaedic Association
British Orthopaedic Association
American Academy of Orthopaedic Surgeons

Owned and published by the American Orthopaedic Association

Published Quarterly:
JAN., APRIL, JULY, and OCT.

The only publication in English dealing exclusively with bone and joint conditions.

Its pages include contributions from recognized leaders in this specialty from foreign countries as well as from the United States and Canada.

In the choice of papers for publication emphasis is laid on the practical and clinical subjects.

A journal of value to general surgeons as well as to those dealing with the problems of orthopaedic and traumatic surgery.

Editor, William A. Rogers, M.D.

8 THE FENWAY, BOSTON 15, MASSACHUSETTS, U. S. A.

——————— Order Blank ———————

The Journal of Bone and Joint Surgery
8 The Fenway, Boston 15, Massachusetts

Please enter my subscription to "The Journal of Bone and Joint Surgery" for one year beginning with the issue for_____

☐ Enclosed find $_____ in payment.
☐ Will remit on receipt of bill.

Name _____

Street _____

City _____

State _____

Subscription Price—Payable in Advance—$5.00 in the United States; $5.25 in Canada; $5.75 in Foreign Countries.

In Post-Tonsillectomy
GRANULAR PHARYNGITIS

SUBSEQUENT to the removal of infected tonsils, a granular pharyngitis may develop with symptoms of a constant sore throat, a sensation of a foreign body in the throat, or a collection of mucus clumps.

Lillie[1] observes that the best method of treatment on an empirical basis is the ingestion of iodides and suggests one tablet of ethyl diiodobrassidate chewed and swallowed from 2 to 4 times a day for a period of 5 days, decreasing as symptoms ameliorate.

Ethyl diiodobrassidate is available as Lipoiodine* in tablets free from local irritating effects and with a lower incidence of iodism in the usual dosage.

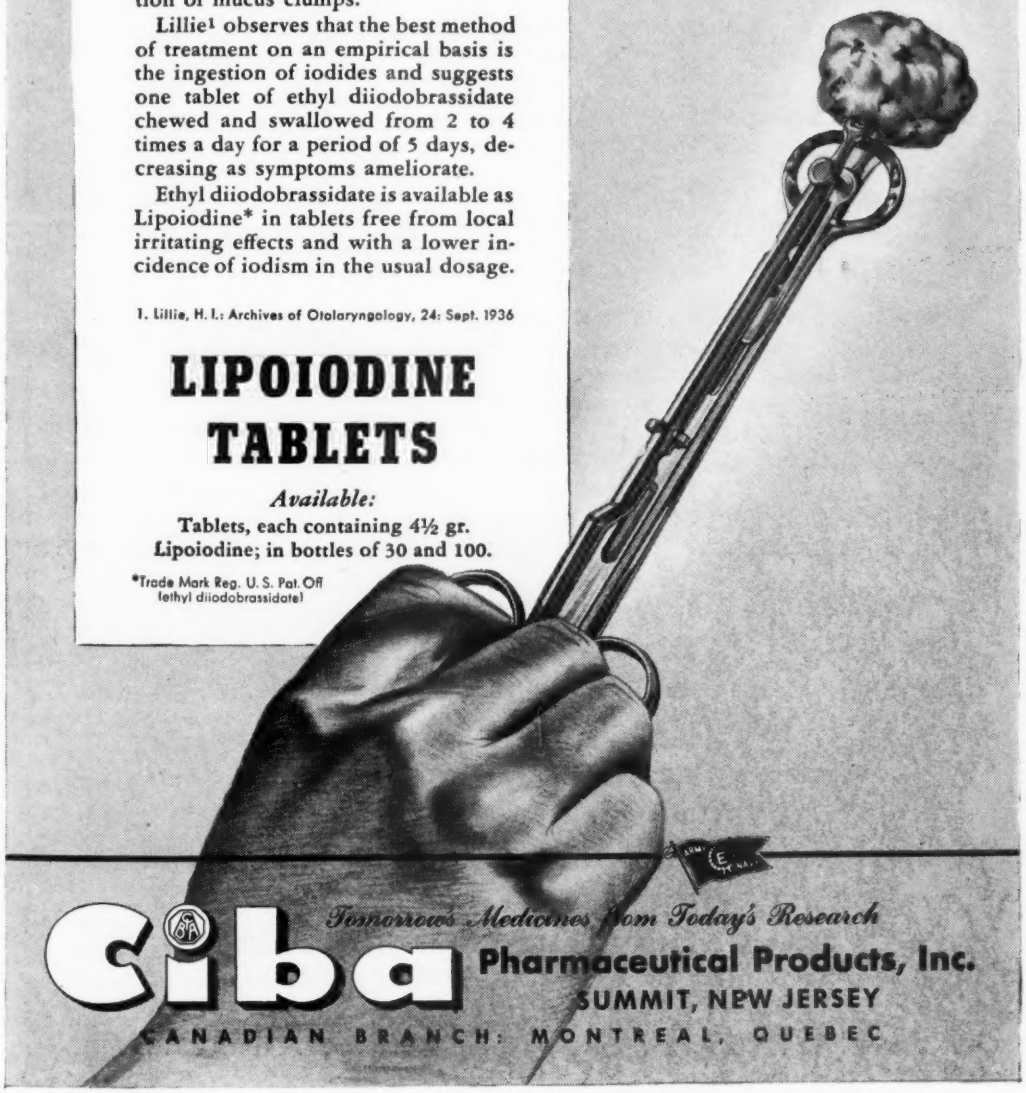
1. Lillie, H. I.: Archives of Otolaryngology, 24: Sept. 1936

LIPOIODINE TABLETS

Available:

Tablets, each containing 4½ gr. Lipoiodine; in bottles of 30 and 100.

*Trade Mark Reg. U. S. Pat. Off (ethyl diiodobrassidate)



Ciba

Tomorrow's Medicines from Today's Research

Pharmaceutical Products, Inc.

SUMMIT, NEW JERSEY

CANADIAN BRANCH: MONTREAL, QUEBEC

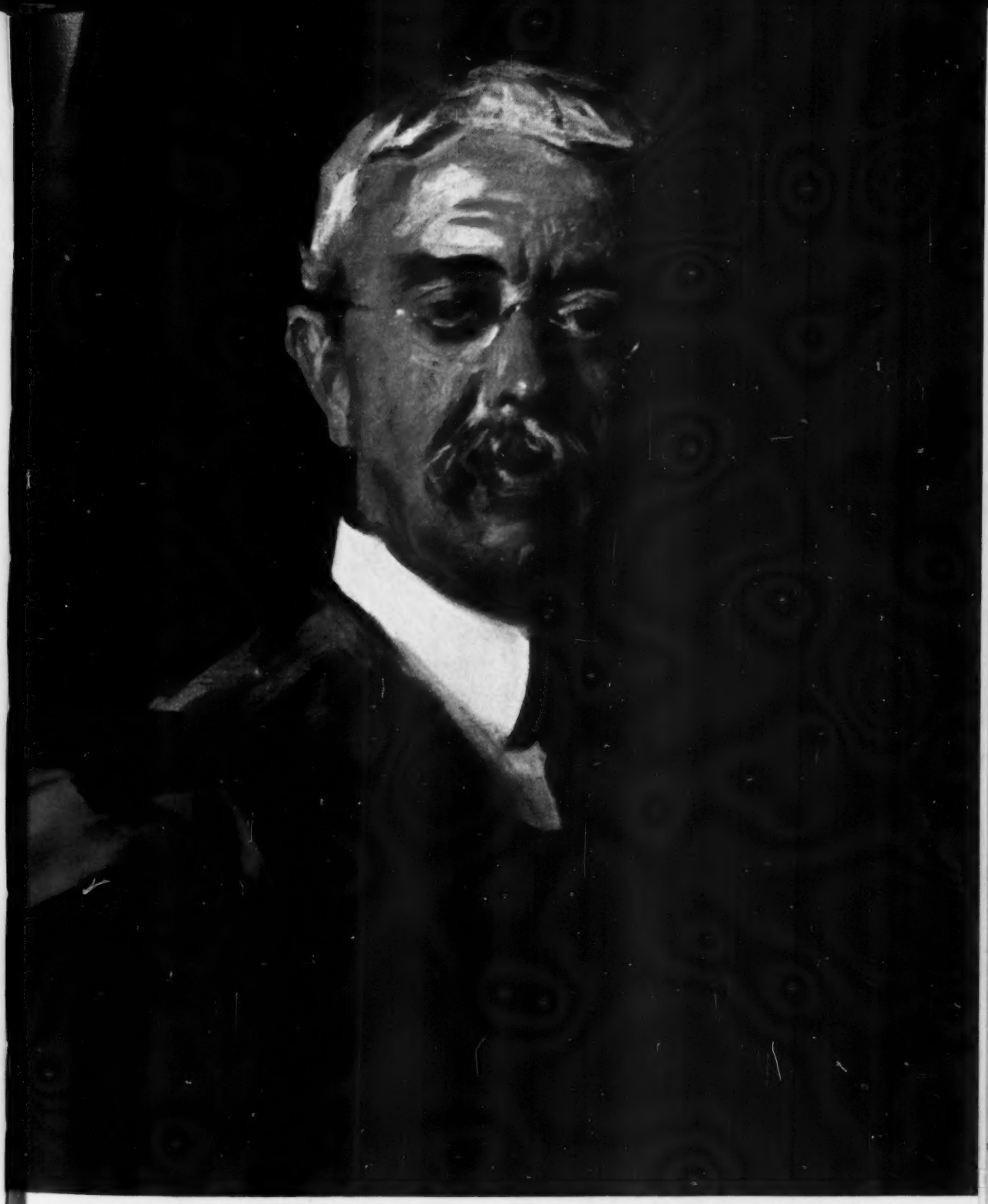
Completely conceals all skin discolorations—
COVERMARK
for post-operative scars, birthmarks, vitiligo, etc.

LYDIA O'LEARY, INC., 551 FIFTH AVENUE, NEW YORK 19 • Chicago (2) 30 N. Michigan Ave

Up-To-Date Books For Surgeons

- **SURGERY OF PANCREATIC TUMORS**—by Alexander Brunschwig. 421 pages, 123 illustrations, 1 color plate. **PRICE, $7.50.**
- **ESSENTIALS OF GENERAL SURGERY**—by Wallace P. Ritchie. 813 pages, 237 illustrations. **PRICE, $8.50.**
- **SYNOPSIS OF OPERATIVE SURGERY**—by H. E. Mobley. 375 pages, 339 illustrations. **PRICE, $5.00.**
- **SYNOPSIS OF THE PREPARATION AND AFTERCARE OF SURGICAL PATIENTS**—by Hugh C. Ilgenfritz and Rawley M. Penick. With a foreword by Urban Maes. 532 pages, 55 illustrations. **PRICE, $5.50.**
- **SURGICAL TREATMENT OF HAND AND FOREARM INFECTIONS**—by A. C. J. Brickel. 300 pages, 166 text illustrations, 35 plates including 10 in color. **PRICE, $7.50.**
- **OPERATIVE GYNECOLOGY**—by Harry Sturgeon Crossen. 5th edition. 1076 pages, 1262 illustrations. **PRICE, $12.50.**
- **FRACTURES, DISLOCATIONS AND SPRAINS**—by J. Albert Key and H. Earle Conwell. Third Edition. 1278 pages, 1259 illustrations. **PRICE, $12.50.**
- **OPERATIVE ORTHOPEDICS**—by Willis C. Campbell. 1154 pages, 845 illustrations, 4 color plates. **PRICE, $12.50.**
- **TRAUMATIC SURGERY OF THE JAWS**—by Kurt H. Thoma. 315 pages, 282 illustrations. **PRICE, $6.00.**
- **SYNOPSIS OF TRAUMATIC INJURIES OF THE FACE AND JAWS**—by Douglas B. Parker. 328 pages, 226 illustrations. **PRICE, $4.50.**
- **HANDBOOK OF ORTHOPEDIC SURGERY**—by Alfred R. Shands, Jr. Second Edition. 567 pages, 154 illustrations. **PRICE, $4.25.**
- **FRACTURES OF THE JAWS AND OTHER FACIAL BONES**—by Glenn Major. 446 pages, 225 illustrations. **PRICE, $7.50.**

The C. V. Mosby Company — Publishers — St. Louis 3, Mo.



FROM THE PORTRAIT BY JOHN SINGER SARGENT — COURTESY SCHOOL OF MEDICINE, UNIVERSITY OF PENNSYLVANIA

J. William White, M.D.

1850-1916

Famous surgeon, teacher and writer. Professor of Clinical Surgery—later, John Rhea Barton Professor of Surgery (1887-1911), School of Medicine, University of Pennsylvania. One of the editors, "Annals of Surgery" (1892-1916). Author, "Genito-Urinary Surgery and Venereal Diseases" (1897).

No. 3 in the series, Great American Surgeons. Reproductions suitable for framing sent free on request to:

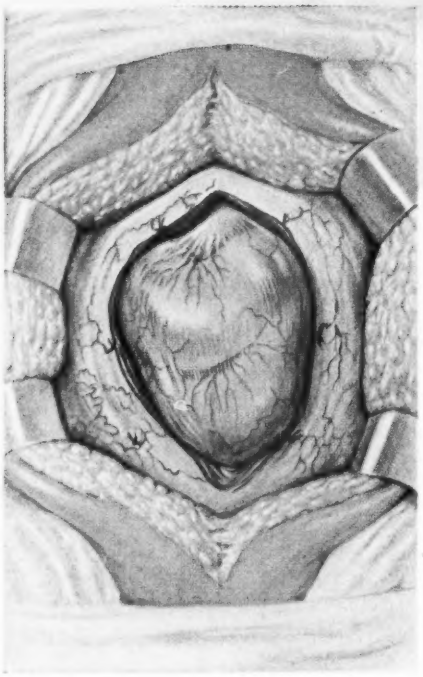
ETHICON SUTURE LABORATORIES, DIVISION OF JOHNSON & JOHNSON, NEW BRUNSWICK, N. J.

Herniotomy for Ventral Hernia

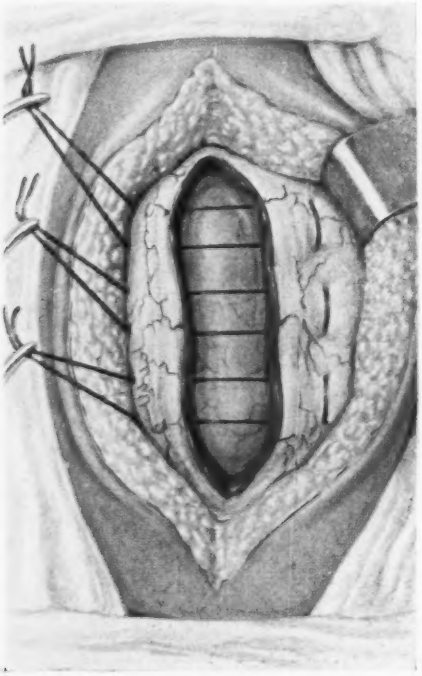
Utilizing Fine Gauge Chromic Catgut and Modification of Edebohl's Technic

This operation demonstrates the manner by which fine gauge chromic catgut may be used to approximate fascia under tension. The placing of heavy gauge temporary tension sutures and secondary incisions make possible thorough and firm approximation by fine gauge chromic sutures.

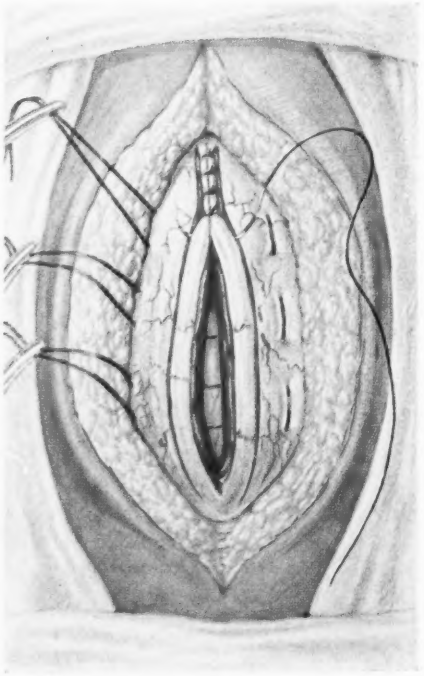
The established principle of the desirability of minimizing tissue reaction is here applied in the use of fine gauge chromic catgut where heavy gauge or non-absorbable suture materials were formerly utilized.



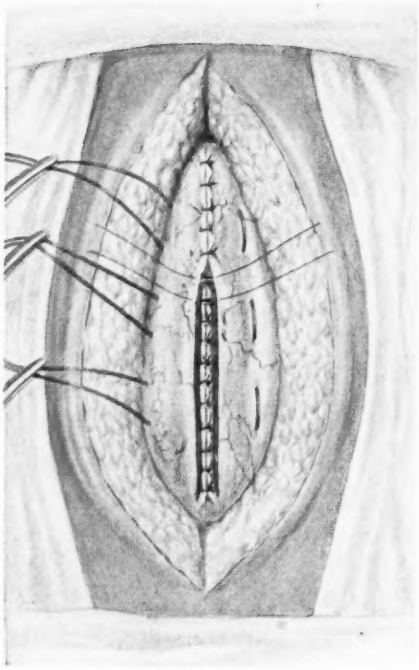
1. The incision has been carried through to the peritoneum. Bleeders have been ligated with Size 000 Medium Chromic Catgut. Note extent of fascial defect.



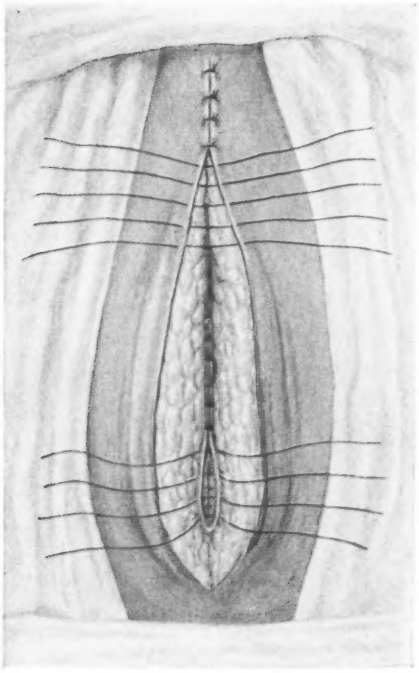
2. Wide area of lateral fascia has been exposed. Three mattress sutures of Size 3 Chromic Catgut or heavy silk have been placed to provide temporary tension.



3. Two longitudinal fascial incisions have been made. The fascia is drawn together by tension applied to temporary sutures and a row of interrupted Size 00 Chromic Catgut Sutures placed. Note use of swedged needle to reduce trauma.



4. Initial row of fascial sutures has been completed. Second layer of fascia is now approximated by interrupted Size 00 Chromic Catgut Sutures.



5. Herniotomy completed with two layers of fascia approximated by interrupted fine gauge chromic sutures. Temporary tension sutures have been removed. Skin closure by interrupted black silk.

For Reduced Trauma..Less Tissue Reaction..Faster Healing
Use Ethicon Tru-Chromicized Fine Gauge Sutures

The advantages of fine gauge suturing, reduced trauma, lessened tissue reaction, faster healing, may be achieved with safety by using Ethicon Tru-chromicized, fine gauge catgut sutures.

• Ethicon fine-gauge sutures possess a greater strength-diameter ratio than larger sizes.

• Gauge uniformity, six times greater than U. S. P. requirements.

• Tru-chromicized fine gauge sutures retain their integrity longer than chromicized sutures of larger gauges.

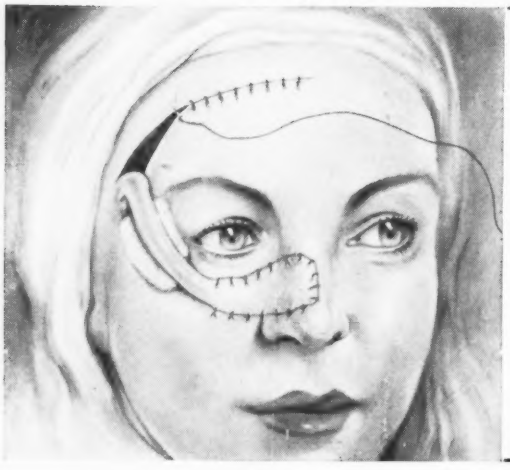
• Exceeding U. S. P. tensile strength requirements (averaging 20% or more on knot pull), Ethicion fine gauge sutures provide a substantial margin of safety against breakage.

To complement your skill as a surgeon, specify Ethicon.

ETHICON
LOCK KNOT
SUTURES

ETHICON SUTURE LABORATORIES

4 new types of
ETHICON SUTURES
for special surgery



Plastic Sutures

Ethicon Plastic Sutures are supplied in Twisted Silk, Surgical Nylon and Drawn Silkworm Gut. They are equipped with specially designed eyeless Atraloc Needles, particularly adapted to plastic or cosmetic surgery.

← Tubed pedicle flap from forehead for repair of middle section of nose and adjacent area (diagrammatic).

Eye Sutures

Special care has been taken to make Ethicon Eye Sutures extremely pliable, to meet the surgeon's need for a suture that passes easily through tissue and ties readily in small areas. Supplied in surgical gut and silk, equipped with eyeless Atraloc Needles.

Gastro-Intestinal

Ethicon Gastro-Intestinal Sutures are supplied in surgical gut, silk, cotton and linen, all with eyeless Atraloc Needles. Several sizes and shapes of needles are available, to meet the varying needs of the surgeon. These sutures are supplied in standard sizes.

Nylon Sutures

Ethicon Surgical Nylon is supplied in standard sizes, sterile in tubes and non-sterile in coils. The tubed sterile nylon is specially processed for improved flexibility and elasticity. It is ready to use, requiring no soaking or conditioning.

Ethicon Surgical Gut Advantages

TRU-GAUGING . . . 6 times greater gauge uniformity than U.S.P. requirements.

GREATER UNIFORMITY OF TENSILE STRENGTH.

TRU-CHROMICIZING . . . uniform distribution of chrome from center to periphery.

LOCK-KNOT FINISH.

ORDER FROM YOUR DEALER

ETHICON SUTURE LABORATORIES

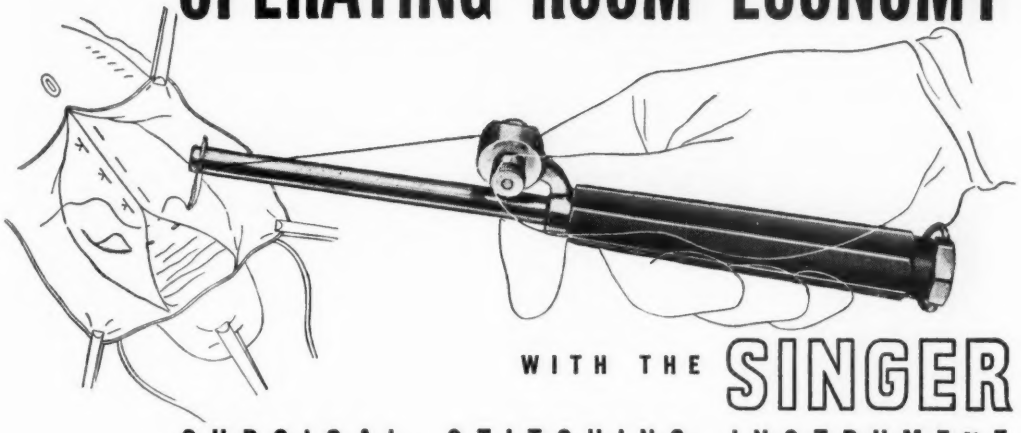
Division of Johnson & Johnson *New Brunswick, N. J.*

World's Largest Manufacturer of Surgical Catgut

Suture Laboratories at New Brunswick, N. J.; Chicago, Ill.; Brazil; Argentina; England; Australia

Copyright 1944, Johnson & Johnson Printed in U. S. A.

SAFER OPERATING ROOM ECONOMY



WITH THE SINGER

SURGICAL STITCHING INSTRUMENT

In advising an operation, the surgeon's sole consideration is the restoration of his patient's health. However, the institution in which the surgery is performed faces certain inescapable economic factors, particularly under present war conditions.

Among the sounder means of achieving economies in the surgical department, with—not less—but *more* consideration for the patient, is the routine use of the Singer Surgical Stitching Instrument.

By replacing numerous individually threaded needles with a single instrument possessing suturing capacity usually sufficient for use in the average operation, nurses can be released from elaborate sterilizing, threading and clamping preparations. And since the surgeon carries the instrument in his own hand constantly while suturing proceeds, attendance of assistants at the operating table may be safely reduced—thus aiding a depleted personnel to carry on with increased efficiency.

This new surgical instrument saves in material costs as well: It uses up considerably less suturing material, and employs a needle that lasts indefinitely. Any standard suture material may be employed, or any needle from a wide variety of available sizes, shapes, or styles—for use in either a deep or superficial field.

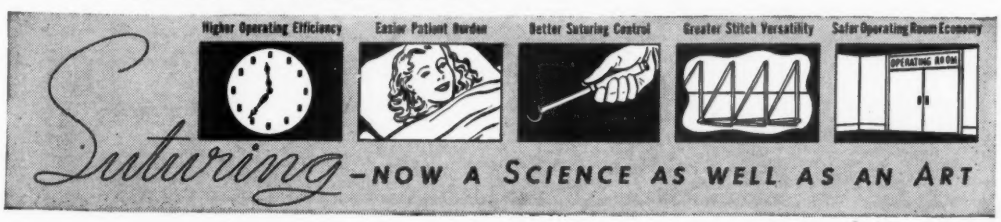
The instrument is sterilized as a complete unit, and may be readily taken apart for cleaning, and reassembled. All parts are rust-resistant.

Illustrated booklet. Write Dept. *H 6*
Motion pictures demonstrating operative technique also available for group meetings.

SINGER SEWING MACHINE COMPANY, ***Surgical Stitching Instrument Division,*** **149 BROADWAY, NEW YORK 6, N. Y.**

Personal demonstration available at your local Singer Shop

Copyright U. S. A., 1944, by The Singer Manufacturing Co. All Rights Reserved for All Countries.



★ FROM THE BEGINNING, Eli Lilly and Company has been active in the development of Penicillin, and for several months has made it available to the armed forces on government allocation and to the Office of Scientific Research and Development.

The material has been so scarce that very little has been available for civilian use, and then only on special assignment. Even in army and navy hospitals it often was restricted to patients unresponsive to sulfa-drug treatment.

Penicillin is now more generally available, and research to achieve the ultimate in chemotherapeutic perfection continues as a major project in the Lilly laboratories.

Eli Lilly and Company, Indianapolis 6, Indiana, U.S.A.

☆ *BUY WAR BONDS FOR VICTORY*

SURGERY

VOL. 15 JUNE, 1944 NO. 6

Original Communications

OBSERVATIONS ON BATTLE FRACTURES OF THE EXTREMITIES

MAJOR OSCAR P. HAMPTON, JR., MEDICAL CORPS, AND
CAPTAIN JOE M. PARKER, MEDICAL CORPS, U. S. ARMY

A GENERAL hospital has now functioned actively in the zone of communications at a base for eight months, during which there have been admitted for definitive care as indicated some 1,400 men with fractures of the extremities due to high-explosive or bullet wounds. Roughly 98 per cent of them were given first aid and their first definitive treatment in forward evacuation or surgical hospitals. If they were evacuated directly to this hospital from evacuation hospitals, they reached us in from one to twelve days. Many, however, were, upon arrival in the base, sent to station hospitals where some definitive care was given or, if the patient's condition permitted, they were transferred to us within two or three days. The forward care has been good and, while it is the purpose of this communication to make suggestions from our observations, we desire to commend the work of the first-aid installations and the forward echelons for definitive care.

The medical installations of the combat zone are principally concerned with:

1. Treatment of shock, including the arrest of hemorrhage
2. The saving of life by any emergency or operative procedure
3. The prevention of infection
4. Preparation of the patient for evacuation to the rear

These apply to all injuries, but discussion will be limited to their application to compound fractures of the extremities. Splendid work has been done in their execution. With modern care relatively few patients fail to "come out" of shock. Many lives have been saved by emergency surgical procedures which have arrested hemorrhage and prevented delayed shock. The prevention of infection always presents a major

Received for publication, Jan. 27, 1944.

problem and a great deal of the responsibility for it rests upon those installations in which the injured man is seen within the first eight to twelve or even twenty-four hours after his injury. It rests principally upon the echelon rendering the first definitive care which, in the cases under discussion, consists of the (1) débridement which includes the cleansing, cutting away of dead and devitalized tissue, and the installation of a sulfonamide drug, (2) the dressing, including use of petroleum jelly gauze or dry gauze, and (3) immobilization of the fracture. All are important.

Orr's principles of "closed plaster" are familiar to all. After a thorough débridement, the wound is dressed with petroleum jelly gauze which acts as a drain, and a plaster cast is applied. The original plaster is not changed for four to five weeks except for specific indications such as persistent pain, fever, etc. This allows complete rest to the fracture and wound and prevents "wound contamination" by dressings. Trueta successfully applied these principles to war surgery with reported very low incidence of bone infection.

By the time of Pearl Harbor, the American medical profession had been well informed on the Trueta method and the results claimed for it by Spanish and British surgeons and also by American surgeons who had worked in England. Certainly when this unit was activated, we all expected to apply rigidly the Orr-Trueta principles but, in addition, to use the sulfonamide drugs locally and by mouth to the limit. We are still "sold" on them, but we have made certain modifications which are to be discussed. But with or without these modifications in the general hospital, the thorough débridement, loose packing, adequate immobilization method plus the local and general use of the sulfonamides offers the forward echelons their principal armamentarium in the prevention of infection. Having carried out these procedures and having combated shock and blood loss, the fourth function of the forward echelons has been carried out because the patient is ready for evacuation to the rear. The only other precaution required is that the cast and underlying sheet wadding be split.

Once the men with compound fractures have reached the general hospital, the primary therapeutic function of that hospital, namely the prevention of deformity, becomes paramount. Needless to say, this problem is greatly facilitated if the prophylactic care against infection has been thorough and successful. In the prevention of deformity, length, alignment, and apposition of fragments must be obtained to a satisfactory degree. At the same time, the general hospital assumes the function of the forward echelons in maintaining prophylaxis against infection. Here again the Orr-Trueta principles are the best guide for this purpose. They must be modified to some extent in order to permit treatment which will prevent deformity as union occurs. Our ex-

perience has convinced us that the closed plaster method, while always desirable, is essential if bone cortex and marrow are exposed as in the tibia, lower fibula, ulna, lower radius, metacarpals, and metatarsals, a superficial group of bones. Where the bone is deep, as the femur, humerus, upper radius, and upper fibula, the closed plaster is essential only until the danger of early sepsis has passed and granulations have covered the bone. As swelling subsides the muscles drop over the bone and protect it from the trauma of dressings. In these instances if balanced skeletal traction, or in humeri, hanging cast traction, is desirable, we have found dressings were safely indicated by the discharge and that the wounds healed as well as under plaster. These points and our methods of preventing deformity are discussed in more detail later.

From our observations and study of the gunshot fractures and other extremity wounds seen in the orthopedic section at our hospital over a period of eight months, some definite ideas have been formed.

SULFANILAMIDE ON THE BATTLEFIELD

A statistical study of 500 consecutive cases of battle casualties made at this hospital has shown that 80 per cent of the patients had sulfanilamide powder sprinkled into their wounds or were given tablets by mouth, or both, within an hour and that within an average of eight hours, 92 per cent had this prophylactic therapy. However, in many instances, we have learned that the tablets of sulfanilamide were not taken by mouth for several reasons; perhaps the soldier could not administer to himself, didn't have a full canteen of water, which he thought essential, or did not have his tablets. Sometimes the drug was placed in the wound when it was bleeding profusely and it was therefore washed out. Many soldiers were not familiar with the use of the drug, either locally or by mouth, and would not have made use of it had not the first-aid man administered it. Some thought it was a painkiller and too often one soldier gave his own prophylactic package to another who had been wounded first so that he had none when injured. In line with accepted experimental work, civilian practice experience, and from deductions made from the study of 500 battle casualties mentioned previously, we are convinced that the local and general use of sulfanilamide is a very important step in the prophylaxis against infection. The sooner after injury the drug is used, the more efficacious it is likely to be; therefore, the soldiers must know how to apply and take it. Soldiers need not know the chemical action or the surgical indications, but we suggest that the soldiers be given repeated instructions in its use as is done in the case of venereal diseases. It has been said, and we agree, that the very low incidence of sepsis is probably due to excellent débridements and excellent first-aid work in the field, which includes local and oral administration of sulfanilamide.

For the low incidence of sepsis that persisted through the Sicilian campaign it seems that the credit should be given to first aid, débridement, and the sulfonamide drugs. We may be too enthusiastic about the beneficial qualities of the drug, but we do not think so, and none of us wants to see the drug omitted. Experimental work of Caldwell has shown that immediate sulfonamide drug installation in compound fractures in dogs, followed six hours later by débridement and more sulfonamide drug, resulted in less sepsis, especially gas gangrene, than when the original drug installation was omitted. Since no harm will result and perhaps many lives and limbs may be saved, the soldiers should have all possible instruction in its use.

DÉBRIDEMENT

The type of missile causing the injury is of importance. The high-explosive fragments usually spoken of as "shrapnel," or referred to respectfully by our boys as "88 shells," in most cases cause the most severe injury. The fragment is usually a large irregular piece of metal that often comes to rest in the soft tissue after fracturing the bone. It usually carries into the wound clothing, leather, dirt, and other organic material to implant bacteria in the excellent culture media created by the metal. The bullet wound, however, is made by a smooth high-velocity missile that in almost every instance perforates. If it perforates it does not carry in foreign material. It is sterile from its heat and infection is not to be expected.

In about 1,400 cases of compound fractures secondary to high-explosive or bullet wounds which were débrided in forward medical installations, we have seen only fifteen to eighteen "septic" cases. By septic we mean cases in which the patients had high temperatures and local signs of spreading infection. These all had, and in our opinion were definitely attributable to, incomplete débridements. Several were understandable as it would have been necessary to lay open completely and excise knee joints. However, this should have been done, and it had to be done by us at our hospital. We are convinced that those wounds in which there have been wide-open classical débridements, as a rule clean up readily and with no signs of sepsis, while those in which there have been minimum débridements often remain slightly febrile and the local wounds drain some pus. By wide-open débridement we do not mean a radical block dissection but rather a thorough job of cutting and cleaning away of destroyed tissue. Very little, if any, skin should be excised, but rather it should be incised so that its length is at least as long as the wound cavity below it. The wound should gape open. This is of maximal importance. Dead and devitalized muscle and fascia must be excised. Exposed fascia is always likely to slough. Foreign material must be removed. When we have removed metallic fragments and occasionally bullets, foreign material such as clothing or shoe leather has been found frequently. This promotes infection.

Metallic foreign bodies of any appreciable size should be removed if it is possible. It is our opinion that battle fractures should be x-rayed prior to débridement so that the operator will not only have some knowledge of the extent of the fracture, but will also know the amount of buried metallic fragments close to the fracture area. If possible, a reasonable amount of irrigation concurrent with the dissection is in order. Active hemorrhage must be controlled by ligature. There should follow a thorough dusting of all planes and crevices of the wound with sulfanilamide powder and loose packing of petroleum jelly gauze. Packing is a misnomer. The gauze should merely be laid in the wound to fill it to, and cover, the skin edge. On many occasions when the casts were taken off and the wounds dressed, tight petroleum jelly packs were found in place, and when these were removed there was a gush of dammed-back discharged. It is realized that in many cases the tight packing was done to control hemorrhage, and that packing loosely inserted becomes tight when the swelling occurs or during the application of a snug plaster. However, it is suggested that loose packs be insured as much as possible and that packing not be inserted under skin flaps. It seems desirable that the petroleum jelly gauze strips be laid from the bottom of the débrided wound out over the skin in an axis at right angles to the wound. Having lain such strips all about the periphery of the wound, the remaining central cavity, if any, can be loosely filled with petroleum jelly gauze folded back and forth. It is worth repeating that the skin incision must be adequate, débridement complete, the sulfanilamide sprinkled into all crevices of the wound, and the petroleum jelly dressing be inserted loosely.

Practically all of the perforating bullet wounds have had simple excisions of the wounds of entrance and exit as their débridements. The self-sterilizing theory of a high-velocity projectile has proved sound and practically all of the wounds healed normally without infection. The more superficial the bone involved, the more careful one must be in handling these wounds both primarily and secondarily in order to prevent infection. In these cases, such as the tibia anteriorly, one may be inclined to incise and débride, but unless there is some reason to expect considerable muscle destruction, a simple excision of the wounds of entrance and exit, sulfonamide drug, dressing, and cast will probably suffice. We can recall no osteomyelitis in patients with perforating bullet wounds that had simple wound excisions, but we have seen several bad looking wounds after too extensive débridement. However, if the missile has penetrated and not perforated, there is the possibility that foreign material is embedded in the wound. For this reason a débridement with removal of the missile and any foreign material is indicated, particularly if the bone is easily accessible. In one wound with a retained bullet we found shoe leather, and in another an eyelet of a legging.

PLASTER CASTS

No patients have come to us in constricting plasters. They have either been observed in circular plasters in forward hospitals a sufficient time for safety or the plasters have been split. There have been no instances of plaster casts breaking. It is suggested that the plaster along the sole of the foot be brought out past the toes to protect them against the pressure of bedclothes, particularly blankets on stretchers, and that long leg casts come as close to the groin as possible. It is important that at the first cast application the foot be brought to a right angle in neutral version. This is often neglected, and after ten to fourteen days have passed when a new cast may be applied, it may be very difficult to obtain the right angle. In fractures of the tibia and fibula, when the foot is pushed up and held at ninety degrees, there will be a tendency for the fracture to bow posteriorly. Flexion at the knee is an aid in preventing the bow, and with effort it can be prevented; therefore the foot should always be held in the optimum position. The plaster should be molded in such a manner as to preserve both arches of the foot, and care should be taken to avoid pushing the toes into dorsiflexion. Patients in hanging plasters for complete fractures of the humerus have not traveled comfortably from the forward area, especially if the bone injury was close to the shoulder. It must always be kept in mind that all patients being evacuated in ambulances or planes must remain recumbent for a long period of time and therefore splinting must be done accordingly. Men with fractures of the middle and upper third of the humerus travel with comparative comfort only in shoulder spicas or modified Velpeau dressings, preferably of plaster. If shoulder spicas are used, the arm and forearm should be forward and not abducted. With the arm in abduction, the patient cannot rest well on the stretcher, and the arm is frequently bumped because it extends "out of bounds." The plaster Velpeau applied with or without a light cast binding the arm and forearm to the body has worked well. The plaster is molded about the arm and forearm before it hardens, thereby holding the arm and forearm snug against the chest. This method is our choice for humerus fractures.

A special recommendation is made for the so-called Tobruk splint for fractures of the femur. All men with fractures of the femur below the trochanteric level, gunshot or otherwise, who have come to us in these splints, have traveled very comfortably even though they have been in them as long as nine or ten days. It is an improvement over the Thomas splint for transportation of the injured and is recommended for fractures of the leg near the knee. A brief description of our conception of the Tobruk splint may be worth while. A strip of three-inch adhesive plaster is applied to each side of the thigh and leg from the level of the fracture site to ten or twelve inches past the foot. A padded plaster cast is then applied from the groin to just past the toes

with the ankle at ninety degrees and the knee flexed ten to twenty degrees. The fracture is held in as good alignment as possible while the cast is applied. A Thomas full- (preferably) or half-ring splint is applied over the extremity, cast and all, and the strips of adhesive, which were made to pass out of the cast just above the malleoli, are tied with tension to the end of the splint. More plaster bandages are then applied at the level of the thigh and leg passing around the cast and splint, thereby holding the leg firmly in the splint. A small stick, or two tongue depressors taped together, should be twisted as a windlass about the strips of tape between the foot and end of the splint. The windlass can be tightened daily if it seems necessary in order to maintain sufficient traction. All patients arriving from the front in body spicas traveled very comfortably, but the Tobruk is more easily applied, since neither a fracture table or a sacral rest is necessary, and it allows the patient to sit up with freedom of the body and the well thigh and hip, which is of value while traveling in an ambulance or plane.

We particularly condemn the use of the skin-tight plaster on the acute injuries, simple or compound, even though it is split to prevent constriction. We have had about twenty patients with fractures of the leg and a few of the arm who have come to us in plaster casts, applied directly to the skin at the time of débridement in the forward hospitals. With very few exceptions the skin has been blistered when these casts were removed. These blisters undoubtedly develop because the skin becomes adherent to the plaster and does not stretch when swelling takes place. Several simple fractures had skin-tight casts and our check x-rays revealed position that required open reduction and internal fixation. When the plasters were removed large blisters were found which prevented the indicated treatment. Sheet cotton, stockinet, cotton batting, cloth of any kind, or newspaper should be used to protect the skin if any of them are available.

When a plaster cast is split as a prophylactic measure or in case of swelling, any underlying blood-soaked sheet cotton, stockinet, or other padding should also be split because they produce constriction. Gauze bandage should not be used to hold a dressing in place under a cast since it is very unyielding. The sheet cotton will hold the dressing in place. An accurate drawing of the fracture and soft tissue wound supplemented by dates of injury, operation, and other markings on the plaster are very helpful to those seeing the patient during evacuation and at the general hospital.

INTERNAL OR PIN FIXATION

We have had twelve patients with high-explosive, bullet, or direct trauma compound fractures who have been treated by débridement and plating, with the wound left open after the installation of sulfanilamide and a loose pack of petroleum jelly gauze. Contrary to our expectations, from our early observations, we could not condemn this proce-

dure. We observed one comminuted fracture of the femur plated eighteen hours after the bullet wound and left open. It closed and healed rapidly. Two other patients (direct trauma) were held in our hospital long enough for us to see clean granulations fill the wound, and there is every expectation that they healed. These, upon whom we cannot render final judgment, were evacuated to the zone of interior. Certainly no instances of sepsis or other immediate untoward results, definitely attributable to the metal fixation, have been seen. However, the last few fractures have not looked as well as the first ones, and we were tempted to remove the plate. We have not done so, however, in order that the method could be given every possible trial, but we are convinced that the poor results will outnumber the good ones and we see no reason to insert metal fixation in these battle compound fractures and thereby enhance the chances of osteomyelitis. We are certain that practically every wound so treated could be handled effectively by other methods as outlined elsewhere. In two instances plates have been used to strut a massive loss of bone substance and thereby prevent shortening. These are indeed problems. If the fibula is intact it will strut the tibia and will be available later for reconstruction surgery. But if the fibula is fractured also it would seem advisable to attempt pushing the tibial fragments together. If the bone loss is too massive, amputation will probably be the end result and simple plaster immobilization should suffice.

About thirty-five patients have come to us with two-wire or Steinmann pin fixation in plaster for fracture of the leg. Several of the wires had cut out of the tibia and through the skin and were infected. Two of the pins placed in the lower end of the femur to strut fractures of the upper tibia into the knee joint were infected. These were cases of poor débridements, and the infection that developed at the fracture site had reached the pins through the joints. In several wounds which were dressed as early as ten to fourteen days after the original casting it was found that the discharge from the wound had traveled underneath the cast and surrounded the pins, some of which were infected. If a forward installation deems it necessary to strut length in compound fractures of the leg, where excessive shortening is to be feared, and yet the patient must be evacuated to a general hospital, perhaps it can be done by two-pin method, but pin infection is likely to result, from our observation. We have surmised that in some instances infected pins have resulted when they were inserted after the débridement and a complete resterilization of instruments and redraping of skin were not done. Certainly in such cases a complete new sterile setup is mandatory. However, we have also seen pins infected from discharge creeping under the cast in cases where the pins were inserted at a general hospital ten to twelve days after the injury. This has been the rule more than the exception. In two instances Steinmann pins were broken, presumably

by the cast rocking as the ambulance passed over rough roads. Others were loose. Wires, not held taut by traction bows, always bend and therefore do not maintain the strut, so they should not be used. One of the criticisms of the two-pin or dual-pin method since its inception has been the possibility of distraction and resulting delayed or non-union. Distraction is too easily obtainable in explosive fractures of the extremities because of the extensive soft tissue and bone damage. It has been observed in two of our cases. For all these reasons we are opposed to the method, especially since other safer, surer methods are available. If it is to be used we suggest that Steinmann pin, and not wires, be used and the lower pin be placed in the os calcis. The pins should be far enough from the wound site to insure no continuity of the wound and pin beneath the skin, and far enough away so that discharge underneath the plaster will not rapidly reach the pin site. Patients having two-pin fixation should have a cross-stick near the foot to prevent rotation of the cast. Rotation permits slight movement of the leg in the cast and thereby produces pressure of cast to pin and pin to bone. The plaster should be as snug fitting as possible. Such wounds especially should have an early dressing and change of plaster, which will be discussed in detail in the next paragraph. However, we would like to emphasize that any patient having two-pin fixation for transportation should be transported early before the plaster loosens. After the latter has occurred, the rocking of the leg over rough roads may rock the pins and result in bone necrosis. We do not believe it is necessary for the forward echelon to strut length if the patients can reach a general hospital in ten to fifteen days. These gunshot or high-explosive injuries are so comminuted that length can easily be regained by skeletal traction even though ten to fifteen days have elapsed since the injury.

DRESSINGS

As stated previously, Orr's teachings have been that in the closed plaster method of treating compound fractures and osteomyelitis, dressings after a good débridement are not necessary and should be done as infrequently as possible, and when they are to be done, a complete change of plaster is indicated rather than a window in the cast. Trueta has expounded the same principles and advocated skin-tight plasters which have been discussed. (In his latest edition, which has just reached us, Trueta states that the first cast may be changed after ten to fifteen days if the odor is too foul.) Both have gone on the theory that dressings often produce wound contamination and result in infection in a field of granulation tissue disturbed and somewhat broken down by the trauma of dressings. Dressings through windows were particularly condemned because of the resulting "window edema." Of course, loss of position and disturbance of the fracture fragments were avoided. Therefore, they have taught, and some Army surgeons have carried out, the

principle of not changing the original plaster or dressing in cases of compound fractures or wounds due to high explosives or bullets. They have been treated by débridement and packing for four to six weeks, or even longer if the patient remained afebrile. The very foul cast odor which always develops from the blood and wound discharge was not considered an indication for a change of plaster and dressing. In a fair number of our cases, approximately twelve to fifteen, we allowed the plaster to remain for about five weeks before the original dressing and cast were changed, but in others we found it necessary or desirable to make the original dressing and change of cast from eight to fifteen days after injury. For several reasons we have concluded that such a relatively early dressing is the more desirable. The wound contamination theory seems to have been exploded. Sulfanilamide sprinkled into the wound at the time of dressing, plus sulfadiazine by mouth, by their bacteriostatic action, seem to prevent wound contamination. In many cases we found petroleum jelly gauze packed tightly into the wound and by early dressing these were removed, thereby preventing the pocketing of discharge. Tight packs have been found so often that we expect them and would dress the wound if for no other reason than to be sure that the dressing was correct. If one is gentle, the granulations will be disturbed but little. Often times the position and particularly the alignment of the fragments can be improved and in those cases where two-pin fixation has been used, contamination of the pins by discharge passing up and down the leg under the plaster may be prevented. With reasonable care, position of fragments is not appreciably disturbed. Therefore, we suggest that most of the cases under discussion have the plaster removed and a careful and proper dressing done about eight to fifteen days after the original injury.

This should be done with sterile precautions, and if the magnitude of the wound warrants it, should be done in the operating room. Excessive sponging and wiping of the wound is not desirable, but rather it and the surrounding skin should be thoroughly cleaned by irrigation with saline solution or sterile water and tincture of green soap. Sulfanilamide, approximately 5 Gm. for the average wound, should be sprinkled into all crevices and over all granulation tissues. The wound should then be loosely packed with petroleum jelly gauze according to the method outlined under débridement, a moderate amount of sterile dressing arranged over the petroleum jelly gauze, and a mildly padded plaster cast applied. Provided the patient remains practically afebrile and pain-free, and if the position of the fracture is satisfactory, this cast may remain without dressing for a period of four to eight weeks. Another advantage of changing the plaster at a relatively early date is that if there is excessive shortening of a leg or thigh this can be overcome by skeletal traction. We have never regretted an early dressing and change of cast, and it is a feeling of satisfaction to know exactly the condition

of the wound and that after a thorough cleansing it has been loosely packed as described. If a pocketing wound is found, we incise the skin to form a gaping wound. If there are large tags of dead tissue, they are cut away, but as a rule the depth of the wound is not disturbed. The amount of discharge which forms after the first dressing is minimal; therefore, the plaster can remain on a longer period of time and allow evacuation of many patients to the zone of interior without fear of untoward results. If the patient remains in our hospital we do not make the second change of plaster for four to six weeks unless indications such as fever or persistent pain arise or the discharge is so great as to soften the cast.

One-hundred-five patients with gunshot and high-explosive fractures of the femur have been treated after they reached us, by traction, using a wire in the tibial tubercle or lower end of the femur in order to prevent shortening. As a rule if the fracture is above the middle of the femur the wire is inserted through the lower end of the femur, and if below the middle, through the tibial tubercle. In this theater there seems to be considerable difference of opinion as to the exact site of preference for a wire. In the femur we go as low as possible, making an effort to place the wire through the condyles just distal to the shaft. It is realized that the most posterior lateral pocket of the knee joint bursa may be penetrated, but this is of no significance during treatment or convalescence. Wires placed above the point where the femur begins to expand to form the condyles are not as satisfactory because the traction and weight of leg will tip the lower fragment alternately in all directions. When the wire is inserted in the tibia it must be far enough from the anterior cortex to prevent it cutting out, but the more posterior and the more distal the wire is placed, the greater are the difficulties in adjusting the traction in the proper line to maintain perfect alignment of the fragments. A properly placed wire traverses the tibia at the level of the highest portion and about one inch deep to the anterior margin of the tibial tubercle. We prefer balanced skeletal traction for these injuries and hold them in traction for about two weeks after false motion ceases at the fracture site and then apply a low, double spica for further immobilization. We have used principally the Thomas splint and the Pierson knee attachment. At one time we had more cases than Pierson attachments so the Joldersma method, which is illustrated in Figs. 1 and 2, was used. It proved to be highly satisfactory. The nurses felt that nursing care was facilitated, as the ring and uprights of the Thomas splint and Pierson attachment were avoided. Pressure sores caused by the ring slipping over the ischial tuberosity against the perineum were likewise avoided. Dressings, particularly those of the posterior thigh, were facilitated. All patients were comfortable. Soft tissue wounds were dressed as seemed necessary with the amount of discharge as the criterion. With few exceptions they

were found to fill rapidly with granulations and to heal normally. We have had no instances of abscess formation or burrowing infection in femoral shaft fractures in American or British soldiers. In those cases of oblique, spiral, or comminuted fractures of the tibia and fibula, either compound or simple, where open reduction is contraindicated, we have found a combination of skeletal traction and plaster of Paris fixation

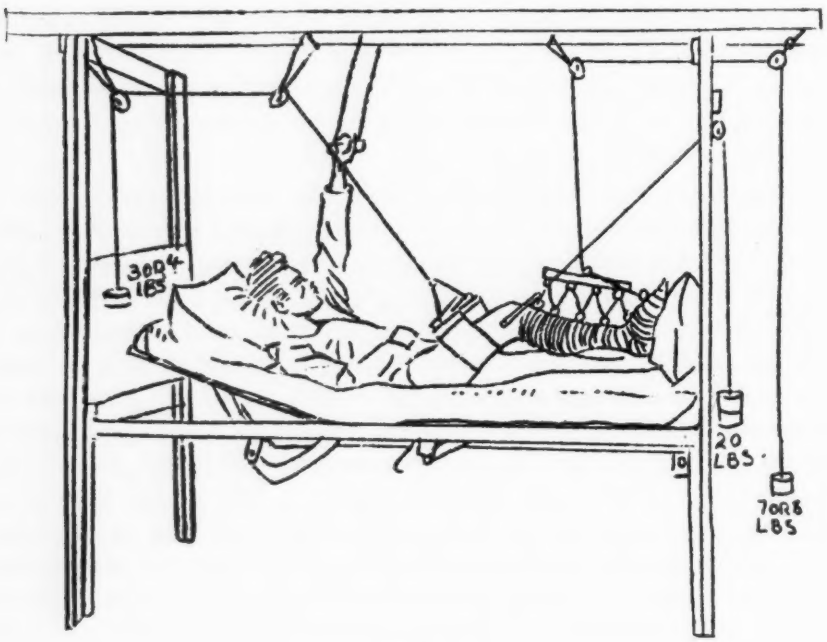


Fig. 1.

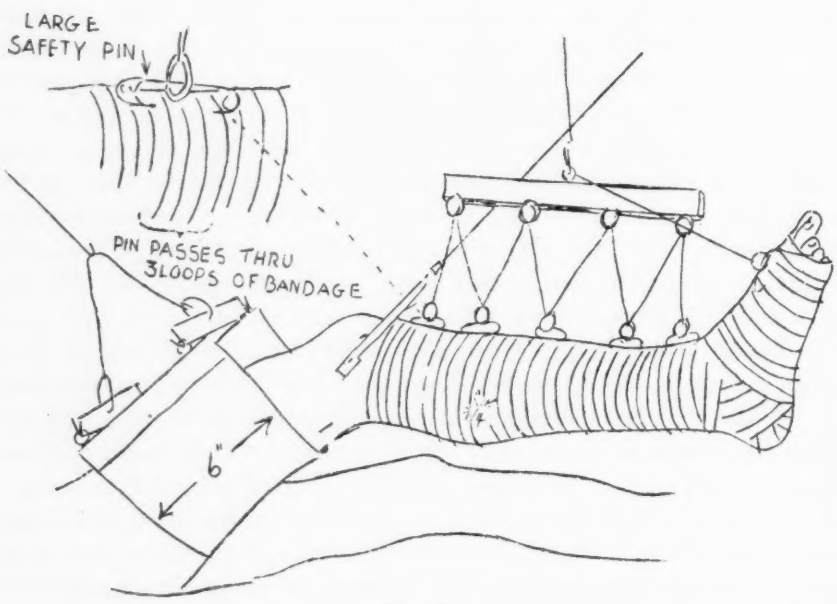


Fig. 2.

very effective. This has been described by Hitchock and also Key and Conwell. A wire is inserted through the os calcis, a traction bow is applied, and from the latter a strong bandage is tied around the waist or hips of an assistant who stands close to the foot and supports it at a right angle, prevents rotation at the fracture site, and maintains constant traction, sufficient to overcome shortening, by leaning backward against the bandage. A small amount of padding is applied to the foot and leg, but at the knee and above, a relatively large amount is used. A plaster cast is applied incorporating the wire and attached bow and made *not tight* or molded at the knee and above. When the patient is returned to bed, about fifteen to eighteen pounds of traction is applied to the bow with the cast resting on a pillow. This method is more efficient than the use of the Thomas splint or the Boehler-Braun frame for traction to the leg because it prevents rotation of the foot, constant angulation at the fracture site, furnishes better immobilization, and yet the traction is just as effective. The cast which was made not too tight above the fracture site and at the knee will slide over the latter. Actually, length should be obtained at the time of casting and maintained by the traction. With this method, traction can be obtained on compound comminuted fractures which are being treated by a closed plaster method for the wounds. Since the leg is elevated on a pillow, the wound discharge does not travel down to the pin in the heel. We have seen no instances of distraction and feel that this is another reason for preferring this method to the two-pin method. Portable x-ray films enable the surgeon to know the position of the fracture, but if these are not feasible one may still be reasonably certain of length and alignment. Cast wedging can be employed if necessary for correction of alignment. When this method is used, a relatively large amount of weight must be used as one is pulling the added cast weight and must overcome the friction of cast on the pillow. Since these patients in traction are necessarily detained for four to six weeks, we have been able to observe the wounds after the removal of the wire and plaster. It is a pleasure to see the granulations that are filling or have filled the wound which has been properly loosely packed prior to the last cast. The advantage of the closed plaster method in a superficial bone is demonstrated, and we feel that the "cast-traction" method is a good one.

Fractured humeri due to bullet or high-explosive injuries have, in most cases, been handled by hanging plasters. Full length and good alignment have been rather easily obtained. If the cast covered the wound, the latter was not dressed until a change of cast was done. If the wound was above the upper margin of the cast, it was dressed as necessary. Here again the bone is relatively deep and the granulations over it are not disturbed by dressings. In those cases involving the shoulder joint where ankylosis was feared, an abduction shoulder spica was used. In those with loss of humeral substance leaving a gap between

the fragments and in a few, usually mid-third fractures, where the weight of the cast has produced distraction, a shoulder spica was also used. In theory, the spica giving complete rest to the part should be preferable as a prophylaxis against infection. This will make a spica more desirable in some cases, but those treated in hanging plasters have responded well and the patients are more comfortable. In addition, the traction of the hanging cast maintains length and reduction, in many cases holding better than a spica. Hanging casts applied with the patient leaning forward, with the arm in the hanging position and elbow at ninety degrees, are more comfortable than those applied with the shoulder rotated externally. Battle compound fractures involving the elbow will usually result in ankylosis. They are best treated by the closed plaster method holding the elbow at a right angle and the forearm in midpronation. The latter point has sometimes been neglected prior to admission to our hospital and considerable difficulty was experienced in trying to obtain it.

It has been surprising how often only one bone of the forearm has been fractured in the type injury under discussion. In such cases the other bone struts the fractured one in order to preserve length. The closed plaster method is desirable and practically all of these wounds have seemed to be granulating normally. The same method is desirable where both bones are involved and since shortening is of relative unimportance in the forearm, traction is seldom indicated. When we have deemed it necessary we have used banjo or balanced traction with a wire through the metacarpals or both bones just above the wrist, depending upon the proximity of the wound. With or without traction, the closed plaster is preferable for wound healing.

When the tarsus, metatarsus, carpus, metacarpus, a superficial group of bones, are involved, the Trueta method as modified is also indicated and has served as well. When the metacarpals are involved in manner which produces shortening, we sometimes use banjo traction in an effort to maintain full length which will be most helpful in rehabilitating the hand. Wire traction passed from dorsal to palmar surface through the nail and distal phalanx has been used. It will be noted that when the wire is inserted in this plane its bent ends do not interfere with the other fingers nor with each other when more than one metacarpal or finger is involved. The same method is used for fingers when it is indicated. Our results in these hand injuries have not pleased us. We know that traction through the fingers must not be maintained too long, yet we like to prevent extreme shortening. Perhaps early amputation of severely injured digits might free the remainder of the hand for early motion, and in the end a better functioning hand be obtained. Many fingers treated vigorously for anatomic healing may still require amputation later if motion is not present in the metacarpophalangeal and proximal interphalangral joints.

JOINT INJURIES

Battle injuries to joints of patients who have been evacuated to this hospital have had, as a rule, care under the same principles as the injuries to bones. Practically the only joint that can be injured without fracture by a shell, bomb fragment, or bullet is the knee joint, and it warrants separate discussion. Penetrating or perforating injuries of the knee have frequently been opened surgically in forward hospitals and any foreign bodies, bone, or cartilage chips removed, the joint irrigated thoroughly, sulfonamide drug inserted into the joint, and the synovial membrane closed; the wound then packed open. All so treated, that we have seen, have done well with a minimum of synovial reaction. Many have had bullet wounds through and through, which had only skin excisions. Most of them healed without infection, but two patients had boggy knees with effusions and temperatures of 99 to 100° F. In these, we carried out aspiration and irrigation with a suspension of sulfanilamide in saline, and instilled into the joint at the conclusion of the irrigation a heavy suspension of sulfanilamide. Sulfadiazine was given by mouth. All became afebrile, and the joint reaction slowly subsided. One shrapnel injury in which the shrapnel had been picked out easily, but no joint lavage carried out according to the record, was treated the same way by us with the same result. Another patient was admitted two days after injury with a temperature of 103° and a hot joint with a large piece of shrapnel protruding through the fat pad into the joint. It was removed after arthrotomy and the routine just described carried out except that the synovia was not closed. He did well, but return of motion was slower than in the others, apparently because of synovial adherence to the femoral condyle. He might have done just as well in overcoming infection if the synovia had been closed. We strongly commend the method as presented in the first paragraph of this section if the treatment can be carried out within eight hours of injury.

After the operative procedure all fractures should be immobilized in a long leg plaster to the groin, and the use of a cross-stick at the ankle to prevent rotation is advisable. The temperature after forty-eight hours is a good index to the presence of joint infection, but in these cases it seems advisable to window the cast to inspect for joint infection. Window edema need not be considered here, as the plaster will be removed after seven to eight days for early motion. Quadriceps exercises in the cast are advisable, not only to prevent muscle atrophy but to keep the patella, anterior joint capsule, and synovia in motion. Several patients with foreign bodies embedded in the knee joint fat pad have required arthrotomy and removal before return to duty. These are probably better removed late than early if the forward installation is sure the fragment is not in the joint cavity.

NERVE INJURIES

Lesions of all extremity nerve trunks and of the cervical, brachial, lumbar, and sacral plexuses as complications of compound fractures have been repeatedly seen here. The extent of the lesions have varied from mild paresthesias in the sensory distribution to total lesions of large nerve trunks such as the sciatic. The nerve function should be tested prior to débridement, and if a paralysis exists and the nerve is within or adjacent to the site of débridement, it should be visualized and a note made as to whether it is intact. We have no experience on which to base an opinion concerning primary suture of nerves.

Proper splinting of paralyzed extremities is important. In the lower extremity a properly applied boot cast holding the foot in neutral version and at 90 degrees (which is the position of choice in almost every cast applied to the foot and leg) will splint all paralyzed muscles in sufficient relaxation. The upper extremity presents a more complex problem. Paralyzed radial nerves are by far the most frequently seen and require more detail splinting. A plaster cast or splint should hold the wrist in dorsiflexion without ulna adduction, hold the thumb in abduction and extension, and extend out to the palmar crease only. Immobilization of the joints distal to this point must be avoided except for brief intervals, or else permanent stiffness will result. Median nerve paralysis cannot be so exactly splinted, but it is well to hold the thumb in a position of opposition if it is possible. Ulnar paralyses usually require no particular splinting. The thumb flexors prevent stretching of the adductor, and daily stretchings of the fourth and fifth fingers with passive joint motion should suffice.

ANTICIPATED DISPOSITION

Very few of these battle casualties under discussion can be expected to return to full duty within the prescribed ninety-day period for patients in this theater. Relatively few may be returned to limited duty. There is a tendency for general hospital units to be overoptimistic about these men returning to duty and, therefore, they may be held two and one-half to three months before it is realized that the patients are not nearly ready for disposition. We made that error in the beginning, but experience taught us some things about the various type cases and we soon began to return more patients earlier to the zone of interior. We were prone to rely on civilian and military hospital experience at home where patients return to their work or their organizations on a restricted activity status. This is not possible in the theater of operations where, when he is discharged to full duty, the soldier must be ready to endure all the hardships of training or combat duty. If he does not "keep up," he will be rehospitalized and his evacuation through the chain will be repeated. The psychic element

then comes into play, because the same soldier will fear his return to duty because he "can't make it."

Hands and feet proved to be the biggest "foolers." At first we thought they should heal and the men be returned to duty. We now know that this is true only in minimal bone and soft tissue injuries usually resulting from small-arms fire, and even these are quite slow. Through-and-through bullet and almost all high-explosive fractures of the hand, except on its borders, so destroy tendons and intrinsic muscles that the disability is prolonged and part of it usually permanent. The same injuries of the bones of the foot, especially those that produce wounds of the plantar surface, are slow to heal and leave feet that are not flexible and are painful with prolonged disability. Phalangeal fractures involving any finger or toe, except the fifth, produce prolonged disability also. With some few of the others the men may return to duty, but they are not many. Therefore, in hand and foot compound fractures, one should expect to return the great majority of patients to the zone of interior, and do so as soon as possible.

Complete fractures of the type being discussed (and also simple shaft fractures), involving both bones of the leg or only the tibia, are zone of interior cases. One may be inclined to hold those patients with wounds involving only the tibia, but experience teaches that they return to duty only after several months. Even limited duty requires a man to be able to stay on his feet for considerable periods of time. For practical purposes, only bullet drill holes have healed rapidly enough to have the patients returned to duty in ninety days. Even the compound fractures of the malleoli heal too slow, as ankle motion is quite restricted. Most fractures of the fibula have responded sufficiently well where the soft tissue wound has not been too extensive. Men with fractures of both bones of the forearm should usually be returned home, although a few, and some with one-bone injuries, may be expected to return to duty in ninety days. We are usually guided by bone loss, tendon or muscle damage, nerve injury, and the extent of the soft tissue wounds. Any of these usually means evacuation to the zone of interior.

All men with fractures of femurs are transferred to the zone of interior as soon as they have been given sufficient definitive care to prevent or minimize deformity and the fractures are casted for travel; the same is done with the majority of the men with fractures of humeri. A few of the latter, involving the shaft and with no nerve and little soft tissue damage, may respond rapidly enough to allow the men to return to duty in ninety days. These are rare and all others should be sent back rapidly. This evacuation can be made with the fracture in hanging plaster, as by this time the patient is ambulatory.

These conclusions are made in spite of our observations that the majority of all fractures, unless there be bone loss, are uniting rapidly.

One must remember that some of the minimal ones will develop minimal osteomyelitis with draining sinuses thus precluding a duty disposition, and this is another reason for transfer. If there is a chance of full duty and a reasonable certainty of limited duty within ninety days, the soldier should be held in this theater. If limited duty is the best expected, and that not certain, and the total hospitalization may exceed ninety days, the soldier should be sent to the zone of the interior.

Of course all soldiers are held and treated in this theater long enough to do all that is possible to prevent or minimize permanent disability. We always keep in mind that only the base echelon can do that which is necessary to prevent deformity. When the soldiers reach the United States it is too late in most cases for any but reconstructive surgery. We want our patients, when they leave for the United States, to be in such local and general condition that they will need no definitive care for four weeks. The time elapsing between our hospital and the hospital for definitive care at home may be less than four weeks, but this time, we feel, is a safe period to allow for embarkation and debarkation delays.

CONCLUSIONS

In conclusion, we would like to again speak favorably of the work as a whole in forward medical echelons. Any suggestions that have been made are meant to be entirely constructive and based on our observations. If those doing primary definitive surgery could visit the base periodically for checkups on their cases, it is reasonable to believe that errors of omission or commission could be corrected. Likewise, observation of forward care by medical officers of base installations would be helpful in order that they might better understand the forward problems.

We would like to re-emphasize the filling of the wound *loosely* with petroleum jelly gauze, and not the packing. We believe that primary internal fixation in high-explosive or bullet compound fractures will prove to be a failure. We definitely prefer that no pins for skeletal traction or plaster fixation be inserted before the patients reach the base. We are definitely opposed to primary skin-tight plasters because of the likelihood of blisters, and we see no real advantages. It is worth repeating, that even after two or even three weeks, shortening can be overcome by skeletal traction set up in a base installation. We are enthusiastic about our cast-traction method as the one of choice in the prevention of deformity and osteomyelitis in high-explosive or bullet fractures of the tibia and fibula. As a final statement: If the forward echelons can prevent infection (their essential purpose in extremity injuries), the base installation should prevent the deformities.

FRACTURES OF THE FEMUR

Results of Treatment Over a Period of Six Years at the Mayo Clinic

Ralph K. Ghormley, M.D.,* George S. Phalen, M.D.,†
Robert E. VanDemark, M.D.,† and Clarence A. Luckey, M.D.‡
Rochester, Minn.

THE treatment of fractures of the femur is a subject of continued interest to surgeons. As such fractures always are serious, the results of treatment should demand careful study from time to time to determine the value of the methods of treatment used, the results from the standpoint of the patient as to amount of remaining disability, if any, and the amount of time lost from work.

The more recent advocates of various types of pin fixation have claimed earlier ambulation, shorter hospitalization, and better results. If older methods are to stand the test of competition with these newer methods they must show results comparable or better in all respects.

Various methods of treatment of these fractures have their proponents and opponents. Some argue that all fractures of the femur should be treated by open operation, others, that open reduction should never be attempted.

Watson-Jones[1] said, "The essentials of treatment of a fracture of the shaft of the femur are—(1) to immobilize completely and uninterruptedly, (2) to maintain full length of the limb, (3) to prevent angulation or rotation of the fragments.

"Apposition of the fragments is relatively unimportant. Indeed, the fracture will unite soundly if the fragments are not in apposition at all, and in children the bony thickening gradually disappears; if full length and normal alignment have been maintained, a perfect result may be expected."

Böhler[2] said that he had treated more than 400 recent fractures of the femur without operation and that union had occurred in all cases. Böhler further stated that "from this experience I am justified in arguing that operation is never necessary in recent fractures of the shaft of the femur."

A less dogmatic attitude was adopted by Key and Conwell,[3] who said, "We see no reason why a patient with a fresh fracture of the shaft of the femur, which is not compound, should be subjected to the dangers incident to an operative reduction; consequently, we do

Received for publication, Jan. 11, 1944.

*Section on Orthopedic Surgery, Mayo Clinic.
†Fellow in Orthopedic Surgery, Mayo Foundation. Now Captain, Medical Corps, Army U. S.
‡Fellow in Surgery, Mayo Foundation. Now Lieutenant, Medical Corps, Army U. S.

not recommend operative treatment until conservative treatment has been tried and failed."

In choosing a method of treatment of fractures of the shaft of the femur, the following facts should be considered: (1) the patient's age and physical condition, (2) the surgeon's skill in using the various methods of treatment available, and (3) the facilities at hand with which to work.

Among the facts to be remembered are several which seem to us important. Manipulation and plaster fixation may result in a good reduction, but locking of the fragments often is not sufficiently strong to prevent overriding in cases of fresh fracture. After two to four weeks, callus may be strong enough to prevent overriding in a cast. No cast, however carefully applied, will absolutely prevent overriding in cases of fresh fracture unless supplemented by traction or pin fixation. Various methods of traction and suspension traction call for skill and knowledge in the use of the method. None of these methods is foolproof and one must exert constant vigilance to gain the best results with traction methods. As a rule, traction methods require longer periods of hospitalization than do other methods. Open reduction with internal fixation usually produces much more secure fixation than is produced by any other method. The patients can be sent home in casts earlier than when other methods are used and they are often more comfortable. Open procedures should be undertaken only when one is certain of the best in operating facilities and technique.

It has been said that the length of time necessary for union to take place is greater after open reduction than it is after closed methods. It was with this statement in mind that we undertook a review of a group of cases of fractured femur observed at the clinic in a period of six years, 1935 to 1940 inclusive. During this period, 103 patients were admitted with fresh fracture of the shaft of the femur. Fourteen of these patients had fractures of both femurs. During this same period, sixty-one patients who had an old fracture of the femoral shaft were treated, and thirty-three pathologic fractures of the femoral shaft were observed. No follow-up study of these groups has been made.

In thirty-six of the 103 cases the patients were less than 16 years of age; in the remaining sixty-seven cases the patients were more than 16 years of age. The type and site of the fractures are shown in Table I. In the cases in which the patients were less than 16 years of age, most of the fractures involved the middle third of the femur. In the cases in which the patients were more than 16 years of age, the upper, middle, and lower thirds of the femur were involved with about equal frequency although there was a slight predominance (thirty-two instances) of fracture of the lower third. In fourteen of these thirty-two instances, the fracture extended into the knee joint. In nine instances, the fracture was supracondylar and did not extend into the

knee joint. Simple transverse fractures predominated in cases in which the patients were less than 16 years of age while comminuted fractures predominated in cases in which the patients were more than 16 years of age. The ages of the patients are shown in Table II.

TABLE I

TYPE AND SITE OF FRACTURES ACCORDING TO AGE OF PATIENTS

TYPE OF FRACTURE	NUMBER OF FRACTURES*					
	IN CASES IN WHICH PATIENTS WERE LESS THAN 16 YR. OF AGE			IN CASES IN WHICH PATIENTS WERE MORE THAN 16 YR. OF AGE		
	PORTION OF FEMUR INVOLVED			PORTION OF FEMUR INVOLVED		
	UPPER	MIDDLE	LOWER	UPPER	MIDDLE	LOWER
Transverse	3	16	4	4	9	4
Spiral oblique	2	3		5		5
Comminuted	2	5	1	11	11	23
Greenstick	1		2			
Compound	1	1	1	2	1	
Total	9	25	8	22	21	32

*Both femurs were fractured in fourteen cases; therefore, there were 117 fractures in the series of 103 cases.

TABLE II

AGE OF PATIENTS BY DECADES

AGE (YR.)	PATIENTS
0 to 9	25
10 to 19	18
20 to 29	14
30 to 39	9
40 to 49	4
50 to 59	8
60 to 69	10
70 to 79	9
80 to 89	6
90 to 99	
Total	103

METHOD OF TREATMENT

On a service such as ours, where several men are responsible for the treatment of the fractures, it should be expected that a variety of methods of treatment be used.

In the cases in which the patients were less than 16 years of age, the treatment most often used was adhesive or skeletal traction followed by a plaster cast (Table III). In some cases, traction was obtained with a Thomas splint and in other cases Russell's type of traction was used. As a rule, traction was maintained until the callus had become sufficiently strong to prevent overriding after removal of the traction, after which a spica cast was applied. The condition of the callus usually was determined by manipulation of the fragments and by roentgenographic examination.

TABLE III

TREATMENT AND RESULTS

TREATMENT	FRACTURES*	TIME REQUIRED FOR UNION		GOOD	FAIR	NON-UNION	DIED	FOLLOW-UP DATA NOT AVAILABLE
		3 MO.	MORE THAN 3 MO.					
In cases in which patients were less than 16 years of age								
None	1	1		1				
Splints only	6	6		6				
Cast (preceded by manipulation in some instances)	3	2	1	3				
Traction only	4†	1	2	3			1	
Traction and cast	20‡	17	2	18				2
Open reduction	8	7	1	7	1			
In cases in which patients were more than 16 years of age								
Cast (preceded by manipulation in some instances)	10	6	4	9	1			
Traction only	14†	7	7	6	4		3	1
Traction and cast	27‡	10	13	22	2	1	1	1
Open reduction	24	4	16	20	1	2	1	1

*A total of 117 fractures occurred in the 103 cases.

†In both groups, traction was the only type of treatment employed in eighteen instances; skin traction was employed in eleven instances and skeletal traction was used in seven instances.

‡In both groups, forty-seven fractures were treated by traction and a cast. Skin traction and a cast were employed in twenty-six instances, skeletal traction and a cast, in fourteen instances, and skin and skeletal traction and a cast, in seven instances.

In cases in which the patients were more than 16 years of age, twenty-seven, or 36 per cent, of the fractures were treated by traction and a plaster cast and twenty-four, or 32 per cent, were treated by open reduction.

RESULTS

The treatment employed and the results of treatment obtained are shown in Table III. Table IV shows the results of open and closed reduction. The evaluation of the results was based on roentgenographic examination, on the appearance of the extremity, and on the function of the extremity, particularly, motion of the hip and knee and the presence or absence of a limp.

There were five deaths in the cases in which closed reduction was employed. One patient died thirteen hours after admission to the hospital as a result of injuries sustained in an accident, one patient died of cerebral thrombosis twelve days after admission, one patient died of pulmonary embolism one month after admission, one patient died of tumor of the brain, and one patient died of carcinoma of the sigmoid colon. Death occurred in only one case in which open reduction was employed. In this case, the patient died of pulmonary embolism thirteen days after the operation.

TABLE IV

RESULTS OF OPEN AND CLOSED REDUCTION

REDUCTION	FRACTURES	TIME REQUIRED FOR UNION		RESULTS				
		3 MO.	MORE THAN 3 MO.	GOOD	FAIR	DIED	NON-UNION	FOLLOW-UP DATA NOT AVAILABLE
Closed	85	50 (58.8%)	26 (30.6%)	68 (80%)	7 (8.2%)	5	1	4
Open	32	11 (34.4%)	17 (53.1%)	27 (84.4%)	2 (6.3%)	1	2	
Total	117*	61 (52.1%)	43 (36.8%)	95 (81.2%)	9 (7.7%)	6	3	4

*These fractures occurred in 103 cases.

Union occurred in three months in fifty, or 58.8 per cent, of the instances in which closed reduction was employed, whereas it occurred in this period in only eleven, or 34.4 per cent, of the instances in which open reduction was employed. In many instances in which open reduction was employed, roentgenograms were not made until more than three months after operation. In ten additional cases union occurred before the end of the fourth month, therefore union occurred in four months in twenty-one, or 65.6 per cent, of the instances in which open reduction was employed. In three additional instances union occurred in five months, in one instance it occurred in seven months, in two instances it occurred in nine months, and in another instance it occurred in ten months.

In twenty-seven of the forty-two instances of fracture in thirty-six cases in which the patients were less than 16 years of age, there was no shortening. In four instances, no mention was made regarding the length of the fractured extremity when the patients were last examined. In five instances, there was shortening of from $\frac{1}{4}$ to $\frac{3}{4}$ inch (0.6 to 1.9 cm.); the average amount of shortening in these instances was $\frac{2}{5}$ inch (1 cm.). Shortening occured in only one of the eight instances in which open reduction was employed; in this instance the amount of shortening was $\frac{1}{4}$ inch (0.6 cm.).

Shortening did not occur in twenty-seven of the seventy-five instances of fracture in the sixty-seven cases in which the patients were more than 16 years of age. In eighteen instances the length of the fractured leg was not measured after the fracture had healed. In four cases, the patients died shortly after the fracture occurred. In nineteen instances, there was shortening of from $\frac{1}{8}$ to 2 inches (0.3 to 5 cm.); the average amount of shortening in these instances was $\frac{8}{10}$ inch (2 cm.). No shortening occurred in fourteen of the twenty-four instances in which open reduction was employed. In three instances, the leg was not measured to determine whether shortening had occurred. Shortening occurred in seven of the twenty-four instances. In one of the seven instances the amount of the shortening was not determined; in the remaining six instances, it averaged $\frac{1}{4}$ inch (0.6 cm.).

Nonunion occurred one of the instances in which closed reduction was employed and in two of the instances in which open reduction was employed. In one of these two instances a Lane plate broke eleven days after it was inserted. Skeletal traction was applied but union did not occur. Six months after the initial operation a bone graft was inserted and union resulted. In the other of these two instances, a steel plate also was used. As union failed to occur in eight months, a bone graft was inserted and fastened with beef bone screws. Four months after this procedure, drainage occurred from the operative site. Nine months after the second operation, the beef bone screws and a small sequestrum were removed. The drainage ceased subsequently. We have discontinued the use of beef bone screws.

Infection developed in four cases of the entire series. In one case of compound fracture, drainage occurred for ten months. In one case in which pins had been inserted for skeletal traction before the patient was brought to the clinic, drainage from the pin holes persisted for three months. In another case, in which the patient had diabetes, there was an infection of the skin at the site of insertion of a Kirschner wire. Septic phlebitis occurred in one case in which open reduction was employed. The patient died of pulmonary embolism on the thirteenth day after operation. This was the only incidence of infection in the cases in which open reduction was employed.

In the case of the eighty-five fractures that were treated by closed reduction, the results were as follows: good in sixty-eight, or 80 per cent, of the instances and fair in seven, or 8.2 per cent, of the instances. The following results were obtained in the treatment of thirty-two fractures by open reduction: good in twenty-seven, or 84.4 per cent, of instances and fair in two, or 6.3 per cent, of instances.

In the thirty-six cases in which the patients were less than 16 years of age, the average period of hospitalization was as follows: 25.8 days in the twenty-six cases in which closed reduction was employed and 23.6 days in the eight cases in which open reduction was employed. In several of the cases in which closed reduction was employed, the fractures were of the greenstick variety or there was very little separation of the fragments. These features tended to reduce the average period of hospitalization in the cases in which closed reduction was employed. In one case of greenstick fracture, hospitalization was not necessary.

In the sixty-seven cases in which the patients were more than 16 years of age, the average period of hospitalization was as follows: sixty-seven days in the forty-three cases in which closed reduction was employed and 71.1 days in the twenty-four cases in which open reduction was employed. In several of the twenty-four cases in which open reduction was employed, the patients chose to remain in the hospital for a considerable time after they could have returned to their homes.

One patient who had two fractures of one femur was in the hospital for 207 days because union occurred rather slowly. The average time that elapsed between the occurrence of the fracture and the employment of open reduction was 13.2 days. In one case, open reduction was not employed until closed methods had been employed for 100 days.

CONCLUSIONS

When one considers that open reduction was selected in instances in which closed reduction did not seem to promise a good result, or after it had been tried and failed, the results seem to warrant the use of open reduction.

When one considers, too, that in many cases the period of hospitalization can be shortened by the use of open reduction with internal fixation and that the patient can be sent home for convalescence, an important economic factor is obvious.

These factors often outweigh the slightly longer time required to obtain union. The end results also make open reduction a very important and useful method in the treatment of some fractures of the femur.

REFERENCES

1. Watson-Jones, Reginald: Fractures and Other Bone and Joint Injuries, Ed. 2, Baltimore, 1941, Williams & Wilkins Company, p. 510.
2. Böhler, Lorenz: Treatment of Fractures, Fourth English edition, Baltimore, 1935, William Wood & Company, p. 360.
3. Key, J. A., and Conwell, H. E.: Fractures, Dislocations, and Sprains, St. Louis, 1934, C. V. Mosby Company, p. 944.

TRAUMATIC SYNOSTOSIS OF THE DISTAL THIRD OF THE RADIUS AND ULNA

CAPTAIN FLOYD HURT AND CAPTAIN SPENCER C. FLO
MEDICAL CORPS, U. S. ARMY
(From the Surgical Service, Station Hospital, Bolling Field, D. C.)

CONGENITAL synostosis of the proximal third of the radius and ulna is not uncommon. Cross[1] says that more than 200 cases have been reported in the literature but the surgical treatment of the congenital type is not satisfactory. However, traumatic synostosis of the shaft seems to be a rare abnormality and we have been able to find

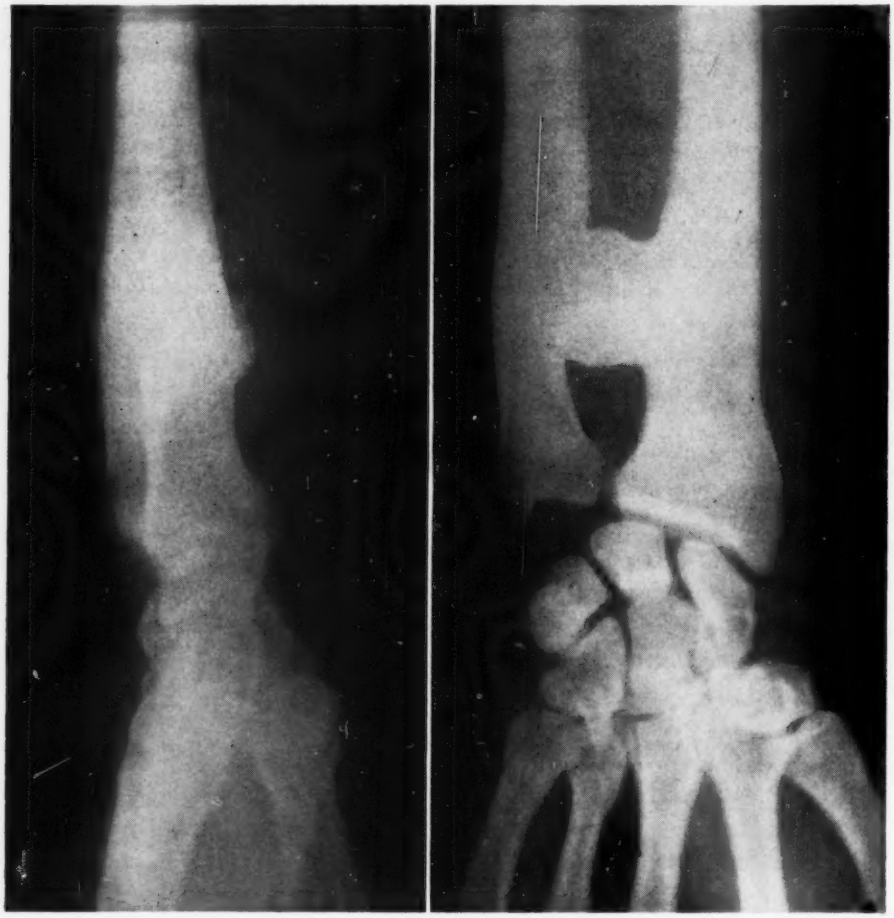


Fig. 1.—Synostosis prior to surgery showing faintly a pseudoarthrosis.

Received for publication, March 7, 1944.

but two cases which have been reported. Cogniaux[2] reported, in 1929, a synostosis which followed a malunion of fractures of the distal thirds of the radius and ulna, which was such that the two bones were in apposition to each other causing a fusion rather than a true synostosis. His treatment was removal of the distal third of the ulna. Key and Conwell[3] reported a case of traumatic synostosis of the shaft cured by simple excision of the bony bridge. They state that one of the complications of fractures of one or both bones of the forearm may be a

Fig. 2.—X-ray immediately following operation showing many small bone fragments near the radius.

synostosis, which is due to the tendency of the bone ends to be drawn together with consequent narrowing of the interosseous space, and can be prevented by properly reducing the fracture. Their x-rays, however, are similar to our case and there did not seem to be any obvious narrowing of the space.

The case we are presenting is interesting for several reasons. The exostosis apparently originated equally from the radius and ulna forming a pseudoarthrosis (Fig. 1). There was no apparent narrowing of

the interosseous space and the fracture was in good position. Portions of the exostosis which were not removed at operation showed gradual absorption rather than regeneration which might be expected.

Because the etiology of the exostosis is not clear we can only offer, as a tentative interpretation, the theory that the injury must have been done to both the radius and the ulna in order to form this apparent joint in the center of the bridge. The formation appears to have grown symmetrically from either side, probably resulting from subperiosteal hematomas with deposition of bone cells within the clots.

Fig. 3.—X-ray picture two months postoperatively. Absorption of most of the fragments as well as some of the remaining bridge can be noted.

CASE REPORT

A 27-year-old soldier came to the station hospital complaining of a painful left forearm. He gave a history of having been struck by a sledge hammer across the forearm in 1934 and was told by a physician at that time that he had suffered a broken arm. An anterior and posterior splint had been applied and left on for two weeks. No manipulation was attempted at the time of fracture and no x-rays were taken. He had satisfactory motion after the splints were removed, but as the years progressed he noticed a gradual diminution of rotation of the forearm

and for the past two years the arm has been fixed in midpronation. There was no marked disability although while working he would often have occasion to twist his arm and at such times the strain would cause swelling and pain in the lower arm.

Fig. 4.—Final results showing further absorption of the remaining stump of bridge.

On examination the forearm was fixed in midpronation and rotation was impossible. There was no visible deformity but on palpation a bony formation could be felt on the flexor surface of the forearm about 6 cm. proximal to the wrist joint. It lay beneath the muscle bellies and did not interfere with the movements of the tendons, but on clenching the fist there was noted some adherence of the muscle to this bony formation. X-ray pictures revealed a bony bridge measuring 1.5 by 3 cm. joining the radius and ulna about 6 cm. proximal to the wrist joint.

At the site where the bridge joined the ulna there was a slight deformity which was attributed to a healed fracture. The radius, however, appeared normal.

At operation an incision was made on the extensor surface. The muscles were not adherent, nor was there a capsule about the exostosis. The bridge of bone was smooth and in its center was a definite line of cleavage which corresponded to the pseudoarthrosis noted in the x-rays. The exostosis was removed and grossly had normal bony structure.

Following operation the arm could be rotated freely, although x-rays showed a small portion of the bridge remaining on the radial side (Fig. 2), with many small spicules of bone lying loose on the ventral aspect in close apposition to the radius. Two months later x-rays showed this portion of the bridge to appear smaller, with all the loose fragments of bone absorbed except one which was adherent to the muscle causing some discomfort (Fig. 3). Another operation was done through the flexor surface to remove this remaining fragment. Following operation the patient had complete range of motion without pain.

SUMMARY

1. A case of traumatic synostosis of the radius and ulna is presented, which apparently originated equally from both bones, and was due to injury of the periosteum rather than any malunion.

2. Simple removal of the exostosis apparently resulted in cure, because subsequent x-rays (Fig. 4) showed absorption rather than regeneration.

REFERENCES

1. Cross, A. R.: Am. J. Dis. Child. **58**: 1259, 1939.
2. Cogniaux, P.: Arch. franco belges de chir. **30**: 32; 496-502, 1929.
3. Key, J. A., and Conwell, H. E.: Textbook. Fractures, Dislocations, and Sprains, Ed. 2, St. Louis, 1942, The C. V. Mosby Company, p. 133.

STUDIES ON BURNS

I. The Effect of Plaster Confinement Applied at Varying Intervals After Burning

E. Meredith Alrich, M.S., M.D., and Edwin P. Lehman, M.D.
Charlottesville, Va.
(From the Department of Surgery and Gynecology, the University of Virginia School of Medicine)

THE practical application of plaster confinement dressings to clinical burns differs from the application in experimental burns since in the former there is usually and unavoidably a considerable period of time between the occurrence of the burn and the institution of local treatment. Because marked loss of fluid into the tissue spaces, beneath the epithelium and even to the outside, occurs early following a burn, it seemed probable that the plasma-conserving function of confinement dressings in clinical burns might be somewhat illusory. The present study on dogs was undertaken to clarify this point. In general it consists of a study of the effects of plaster confinement applied at varying intervals following a standard burn on the composition of the circulating blood and the lymph from the burned area. Data were also obtained on the local effects of this form of treatment.

The method of plaster confinement was introduced experimentally by Glenn, Gilbert, and Drinker[1] and has been applied clinically by Levenson and Lund.[2] These authors give references to scattered earlier applications of the principle. Sellers and Willard[3] have recently reported experimental studies demonstrating decreased mortality rates and absent or diminished hemoconcentration when plaster was applied to the burned area immediately. On theoretical grounds they believe early application to be essential for this effect.

It is important to distinguish between plaster confinement of a burn and pressure dressing. The latter, now widely adopted as standard treatment, was introduced by Allen and Koch.[4] The effects of local pressure in the burned area on the composition of the circulating blood have been studied by Siler and Reid[5] and by Lischer and Elman.[6] In the studies of Siler and Reid pressure was applied to experimentally burned areas immediately after burning, and in the studies of Lischer and Elman, one hour after burning. Both studies showed less hemoconcentration in experimental animals than in controls. Since the methods employed were dissimilar, it is impossible to compare the

This study represents a portion of the work done in fulfillment of the requirements for the degree of Master of Science by the senior author.

Received for publication, March 9, 1944.

results of the two investigations quantitatively. It is conceivable that pressure dressings applied late might be effective in returning some of the extravasated plasma to the blood stream, a result not to be anticipated with simple confining dressings.

METHODS

Mongrel dogs varying in weight from ten to forty pounds were employed. They were given an adequate laboratory diet and kept in relatively small cages while wearing a confining cast.

Nembutal in 10 per cent solution was used for anesthesia, being given either intravenously or intraperitoneally. All the dogs were kept under anesthesia for the first twelve hours.

A burn was produced by immersion of a foot up to the radiocarpal joint in water at 100° F., for thirty seconds, a principle which has been employed by Glenn, Peterson, and Drinker[7] for producing a fairly constant degree of burn damage.

A cast was applied to the burned area after varying intervals by placing the foot in a suitably sized metal can, into which thin plaster of Paris was immediately poured. The can was split into equal halves which were held together with adhesive tape. The plaster of Paris was of such consistency that it would readily fill all the space completely and yet set firmly enough in three to four minutes so that the supporting can could be removed. All the casts, with the exception of several in the early part of the work, were dried in a current of warm air for a period of four to five hours. After drying, a metal can with numerous perforations was placed over the plaster for protection. In this way the effects of maceration from wet plaster were minimized.

The animals were divided into two groups: Group I, those in which only one foot was burned; and Group II, those in which all four feet were burned. The first group was further divided into subgroups in respect to the time after burning at which the cast was applied. The interval varied from immediately after burning, in fifteen-minute increments, up to and including one hour. In Group II the casts were applied either immediately or one hour after burning. There were also, in each group, control animals which had no casts applied.

The lymphatics were cannulated just above the planned upper limit of the burn before burning so that a control lymph protein might be obtained. Samples were collected three, six, and twelve hours after the burn, when possible. Lymph samples were collected only in those dogs having one foot burned, and then only in one or more dogs in each of the subgroups.

Hematocrit readings, plasma protein, and blood nonprotein nitrogen were determined just before the burn, and at three, six, twelve, twenty-four, forty-eight, and seventy-two hours after the burn in Group I, and at the same intervals until the animal was sacrificed in Group II.

Pressures within the casts were recorded by snugly strapping a small rubber balloon filled with water against the anterior surface of the foot before applying the plaster. The balloon was connected to a water manometer, the pressure on the system was adjusted to zero, and the plaster cast was then poured in the usual manner. Pressures were recorded only in one or more animals in each subgroup of Group I.

Lymph protein and plasma protein determinations were done in duplicate by the micro-Kjeldahl method. Nonprotein nitrogen determinations on both the lymph and plasma were made, also in duplicate, according to the Koch-McMeekin method modified for titration as in the micro-Kjeldahl method. Hematocrit readings were determined by using Wintrobe tubes and centrifuging for one hour. Heparin* was used as an anticoagulant for both the blood and lymph samples.

Casts were removed on the ninth to the twenty-fourth day after the burn in Group I, whereas the dogs in Group II were sacrificed after thirty hours.

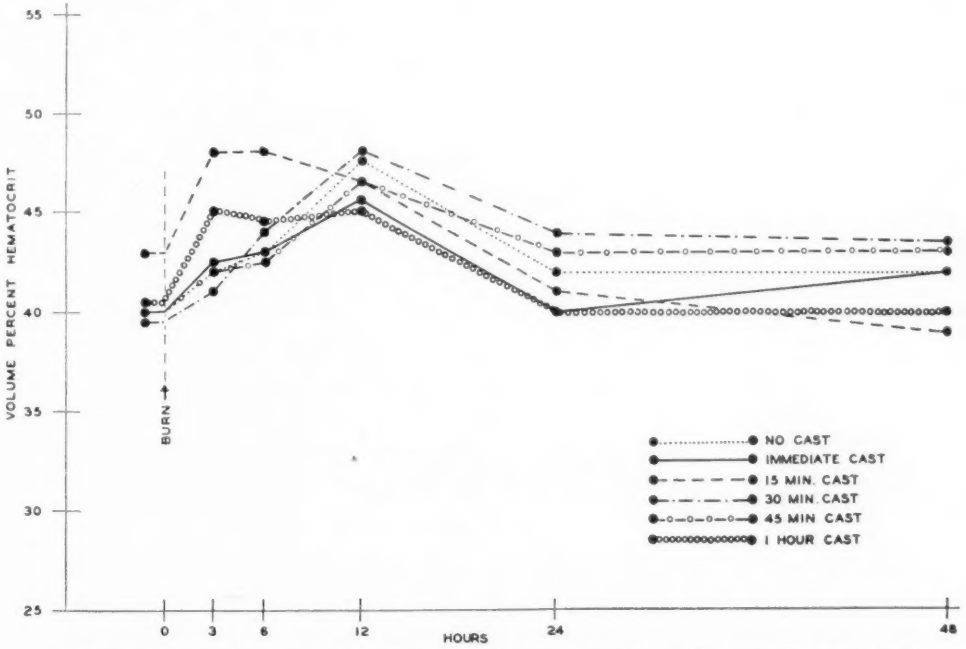


Fig. 1.—Group I, one foot burned. Each curve presents the average hematocrit readings of from four to seven animals. There is no correlation among the results in subgroups in which no cast was applied or a cast applied at varying intervals after the burn.

RESULTS

Group I (One Extremity Burned).—There were four control animals which had no cast applied. The average control hematocrit was 40, from which it rose over a period of twelve hours, reaching a maximum of 47 (Fig. 1). The plasma protein fell 0.4 Gm. per cent below the

*Liquaemin, furnished by the courtesy of Roche-Organon, Inc.

control level over a period of twenty-four hours, but returned to the control level of 6.0 Gm. per cent in the next twenty-four hours (Fig. 2).

In the seven animals which had a cast applied immediately after burning, the hematocrit rose over a period of twelve hours, reaching a maximum, at that time, of 5 per cent above the control level (Fig. 1). The plasma protein did not change over the first twenty-four hours, but forty-eight hours after burning was 0.3 Gm. per cent above the control level of 6.2 Gm. per cent (Fig. 2).

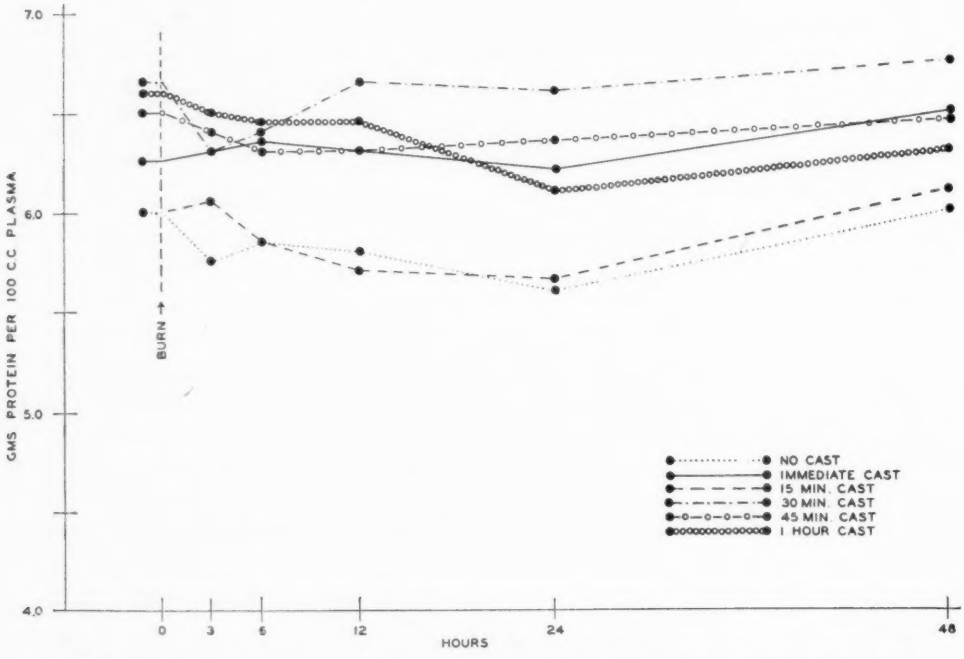


Fig. 2.—Group I, one foot burned. Each curve presents the average plasma protein concentration of from four to seven animals. The degree of fall in plasma protein shows a possible slight correlation with the interval between the burn and the application of a cast.

In the seven animals having a cast applied fifteen minutes after burning, the hematocrit rose to a maximum of 48, which was 5 per cent above the control level, in six hours (Fig. 1). The plasma protein fell over a period of twenty-four hours, to 0.3 Gm. per cent below the control level, but twenty-four hours later was 0.1 Gm. per cent above the control level of 6.0 Gm. per cent (Fig. 2).

In the five animals having a cast applied thirty minutes after burning, the hematocrit rose 9 per cent above the control level of 39 in twelve hours (Fig. 1). The plasma protein fell 0.3 Gm. per cent below the control level of 6.6 Gm. per cent three hours after burning, but returned to the control level within twelve hours and remained at this level (Fig. 2).

The five animals which had a cast applied forty-five minutes after burning had a rise in the hematocrit of 6 per cent above the control level of 40 (Fig. 1), whereas the plasma protein showed essentially no change over a period of forty-eight hours (Fig. 2).

In the five animals which had a cast applied one hour after burning, the hematocrit rose 5 per cent above the control level of 40 per cent (Fig. 1) and the plasma protein fell 0.4 Gm. per cent below the control level of 6.6 Gm. per cent over a period of twelve hours (Fig. 2).

The sloughing of tissue in the confined burns appeared to be less extensive than in the controls. In all of the animals with casts there were only three which showed loss of as much tissue as the control animals which had no casts applied, and these three were among those done during the first part of the experimental work at which time no particular effort was made to extend the plaster well above the burned area. All three of these developed considerable edema above the cast.

Pressures within the casts were never found above the capillary pressure to be expected in areas of inflammation, although those up to and including the group which had the cast applied forty-five minutes after burning were higher than those in which the casts were applied after one hour (Fig. 3).

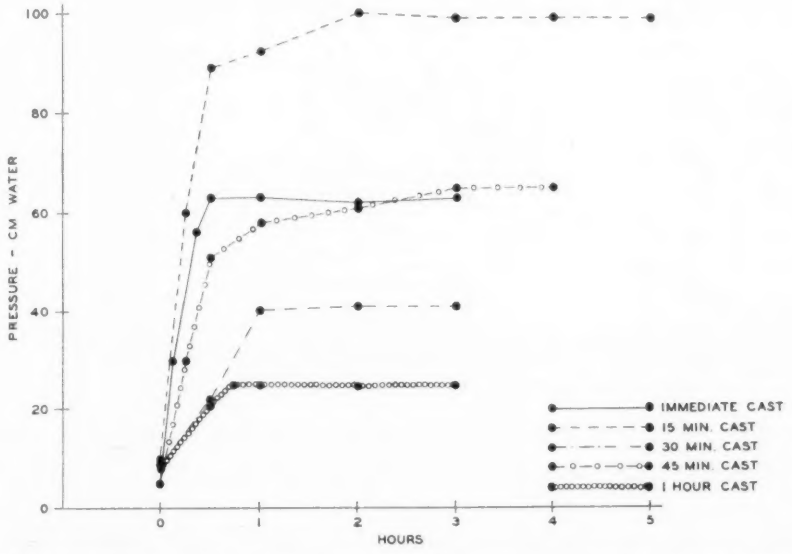


Fig. 3.—Group I, one foot burned. Averages of pressures within cast as registered kymographically. As would be predicted, the smallest rise in pressure occurred in the animals casted at one hour after burning when 90 per cent of the swelling has occurred. Other averages are less consistent.

Averages of the lymph proteins in all of the subgroups reveal that the control levels are about 1 Gm. per cent (Fig. 4). Over a period of three hours the lymph protein rose to a level of four to five grams per cent, where it remained as long as lymph samples could be collected.

Group II (Four Extremities Burned).—In three animals in which no casts were applied there was a rather marked and constant fall in plasma proteins over twenty-four hours, at which time it was 0.6 Gm. below the control level (Fig. 5). The greatest rise in the hematocrit was 13 per cent above the control level, and at the end of twenty-four hours the hematocrit was 4 per cent below the control level (Fig. 6).

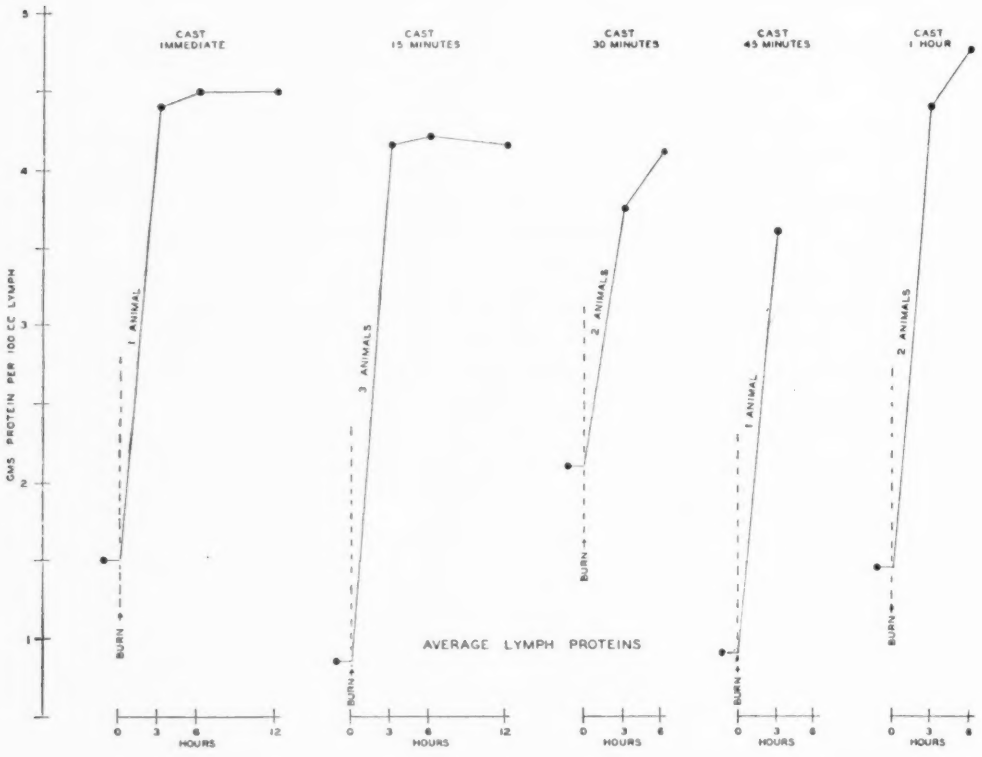


Fig. 4.—Group I, one foot burned. Average concentration of protein in the lymph from the burned area. The rate and degree of rise does not vary with the time of application of the cast.

In five animals in which the casts were applied immediately, there was essentially no change in the plasma protein (Fig. 5), while the greatest rise in the hematocrit was 9 per cent above the control level and there was a return of the hematocrit to the control level in twenty-four hours (Fig. 6).

In the five animals in which the casts were applied one hour after the burn, there was a gradual fall in the plasma protein of 0.9 Gm. below the control level (Fig. 5). The greatest rise in the hematocrits was 17 per cent above the control level, and at the time the dogs were sacrificed, thirty hours after the burn, the hematocrit was still 6 per cent above the control level (Fig. 6).

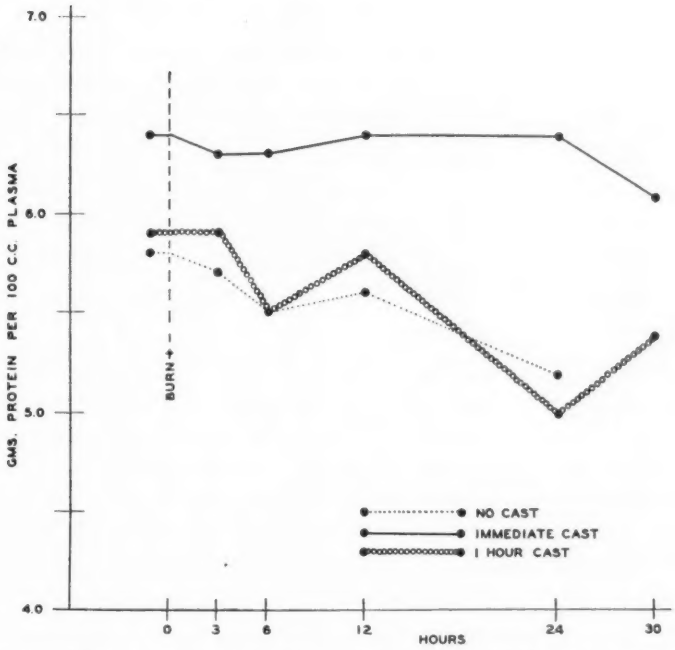


Fig. 5.—Group II, four feet burned. Each curve presents the average plasma pro ein concentration of from three to five animals. In the dogs with a cast applied immediately there was no fall in plasma protein, whereas in the dogs with no cast or a cast applied an hour after burning, there was a significant fall of plasma protein.

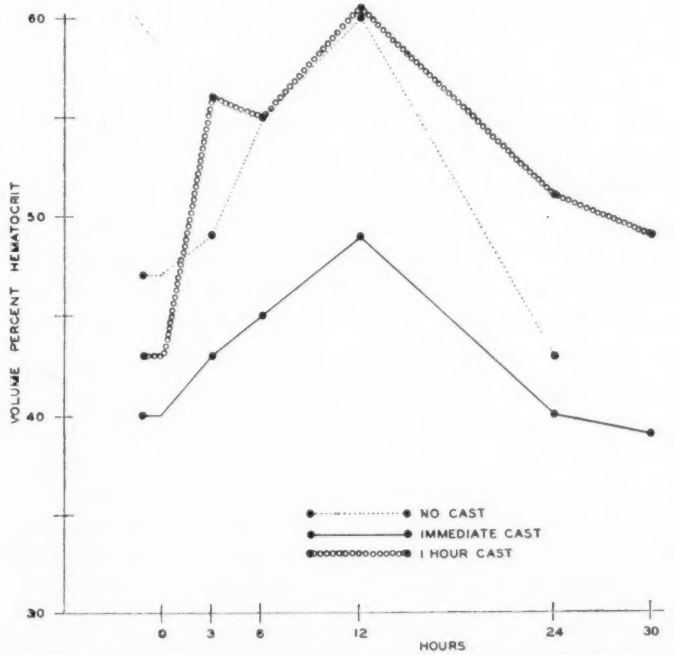


Fig. 6.—Group II, four feet burned. Each curve presents the average of hematocrit readings from three to five animals. The animals with casts applied immediately after burning showed less rise in hematocrit than those with no cast or a cast applied after one hour.

DISCUSSION

In the animals in Group I, which had only one extremity burned, the hematocrits and plasma proteins were found to be essentially the same in all the subgroups, except that the control animals showed a slightly greater fall in the plasma protein than those in which a cast was applied immediately. If the principle is correct that confinement of a burned extremity will prevent plasma loss, then these experiments should have shown a more definite indication of loss of protein and fluid directly related to the time interval between the burn and the confinement.

The absence of this relationship in Group I might be due to the fact that the size of the burn was not sufficient to create striking enough changes. The experiments of Group II therefore, were carried out with a burn four times as extensive. In the animals which had the casts applied immediately there was no fall in the plasma protein, while the animals having either no casts or casts applied one hour after burning showed a fall in the plasma proteins. The hematocrits showed a similar correlation, the greatest rise being in the animals having either no cast or a cast applied one hour after burning, while the animals with casts applied immediately had a smaller degree of rise in the hematocrit. Although the number of animals is too small and the differences in the values not great enough to permit definite conclusions, there is suggestive evidence that a confining type of dressing will lessen fluid and protein loss in a burned area, if applied promptly.

The interpretation of the variations of pressure within the casts in the various subgroups of Group I is not clear. There seems to be no positive correlation between the time of application of the cast and the amount of pressure developed, except that the pressure is lowest in the cast applied last, that is, after one hour. This would, of course, be the predicted result since preliminary studies revealed that 90 per cent of the increase of volume of a burned area occurs in the first hour. It is possible that technical difficulties account for the inconsistencies.

An interesting collateral observation relates to the lymph protein content from the burned areas. In spite of the assumption, which is borne out by the results in the animals in Group II, that less plasma leaves the circulation when a cast is applied immediately than when applied later, no evidence of this phenomenon is shown by the concentration of protein in the lymph. The rate of rise and ultimate level of protein concentration in the lymph are quite as great after the immediate application of a cast as when the cast is applied after one hour.

In general these experiments tend to substantiate the hypothesis that confinement of a burn in a cast protects the circulating blood volume. They also suggest that the time of application of the confining dressing is of major importance. This type of dressing, therefore, is not per-

fectly adapted to the care of clinical burns that are treated more than an hour or so after injury, from the point of view of preventing plasma loss. Since, however, there is evidence that local tissue loss is decreased, the use of this type of treatment is certainly not contraindicated. Whether or not pressure dressings in contradistinction to simple confining dressings are effective in returning already extravasated plasma to the circulation is not shown by this study.

CONCLUSIONS

1. Evidence is presented that plaster confinement of an experimental burn decreases the loss of plasma from the circulation.

2. This effect depends at least to some degree on the time at which the confinement is initiated, being less evident at longer intervals after the burn.

3. Confining dressings have a favorable effect on local tissue loss.

4. In the clinical use of plaster confinement dressings for burns, as distinguished from the more commonly employed pressure dressings, the probable ineffectiveness of late application in preventing plasma loss should be kept in mind.

REFERENCES

1. Glenn, W. W. L., Gilbert, H. H., and Drinker, C. K.: The Treatment of Burns by the Closed Plaster Method, With Certain Physiological Considerations Implicit in the Success of This Technique, J. Clin. Investigation **22**: 609, 1943.
2. Levenson, S. M., and Lund, C. C.: Close Fitting Plaster Casts in the Treatment of Burns of the Extremities, J. A. M. A. **123**: 272, 1943.
3. Sellers, E. A., and Willard, J. W.: The Effect of Plaster Bandages on Hemoconcentration and Mortality Rate in Burns, Canad. M. A. J. **49**: 461, 1943.
4. Allen, H. S., and Koch, S. L.: The Treatment of Patients With Severe Burns, Surg., Gynec. & Obst. **74**: 914, 1942.
5. Siler, V. E., and Reid, M. R.: Clinical and Experimental Studies With the Koch Method of Treatment of Heat Burns, Ann. Surg. **115**: 1106, 1942.
6. Lischer, C., and Elman, R.: Experimental Burns, II. Effect of Elastic Pressure Applied to a Burned Area, War Med. **3**: 482, 1943.
7. Glenn, W. W. L., Peterson, D. K., and Drinker, C. K.: The Flow of Lymph From Burned Tissue, With Particular Reference to the Effects of Fibrin Formation Upon Lymph Drainage and Composition, SURGERY **12**: 685, 1942.

STUDIES ON BURNS

II. Observations on a Vasoconstrictor Substance in Lymph From a Burned Area

E. Meredith Alrich, M.S., M.D., Charlottesville, Va.

(From the Department of Surgery and Gynecology, University of Virginia School of Medicine)

THE possibility of the formation of a toxin in a burned area of skin has been the occasion for much experimental work[1] which, however, up to the present time has not been conclusive. There is suggestive evidence both collateral and direct that abnormal substances reach the blood stream following burns. During studies on burns by Aldrich and Lehman,[2] the opportunity was presented to measure vasoconstrictor effects in lymph from a burned area by perfusion of the rabbit's ear. This study offers evidence of the existence of a vasoconstrictor substance in the lymph from a burned area.

METHODS

Dogs under usual laboratory conditions were employed, divided into control and experimental animals. The latter were subjected under nembutal anesthesia to a standard hot-water burn of a paw according to the method of Glenn, Peterson, and Drinker.[3] In both groups a lymph vessel leading from the paw was cannulated and samples of lymph, heparinized as the fluid entered the cannula, were collected. In the burned animals the lymph flow was spontaneous; in the control animals mechanically effected passive motion of the paw was necessary to obtain adequate samples.

Hourly samples of lymph were obtained for study and were passed through the perfused rabbit's ear in varying amounts. The technique of perfusion was in detail that described by Landis and his associates.[4] The presence of a vasoconstricting substance was indicated by a decrease in the electrically recorded drop rate from the ear vein. Since vasoconstrictor substances are developed in the process of coagulation,[4] both the control and experimental observations were carried out in previously heparinized as well as in previously normal dogs.

The drop rates were plotted as graphs (Figs. 1, 2, and 3), and the area in square inches subtended on the control level by the plotted curve following each observation was calculated and recorded as plus if the drop rate increased above the control level and minus if the drop rate decreased below the control level.

Received for publication. March 9, 1944.

In the course of the experimental studies either an inert solution (Ringer-Locke) or adrenalin was injected from time to time into the perfusion system to test the continued integrity and sensitivity of the preparation. No perfused ear was employed after an adrenalin test showed a failure of response or of postconstriction recovery. A "plus"

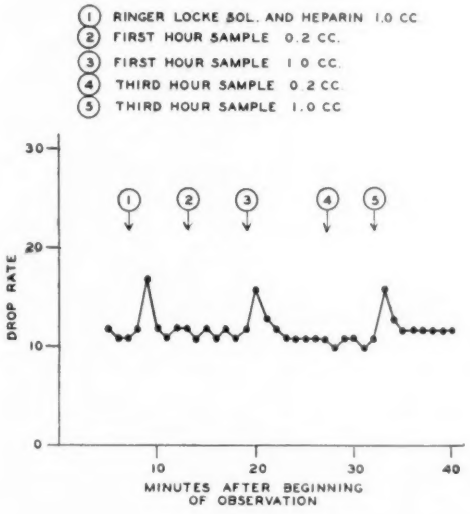

1 RINGER LOCKE SOL. AND HEPARIN 1.0 CC
2 FIRST HOUR SAMPLE 0.2 CC.
3 FIRST HOUR SAMPLE 1.0 CC.
4 THIRD HOUR SAMPLE 0.2 CC.
5 THIRD HOUR SAMPLE 1.0 CC.
DROP RATE
MINUTES AFTER BEGINNING OF OBSERVATION

Fig. 1.

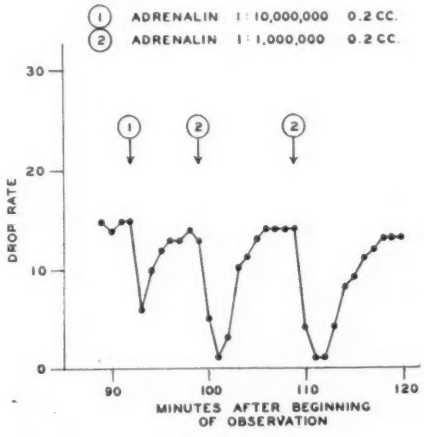


Fig. 2.

Fig. 1.—Curve of drop rate from a rabbit's ear perfused with lymph from an unburned unheparinized dog. Each dot on the curve represents drops per minute. An increase in drop rate is seen following perfusion with 1 c.c. of Ringer-Locke solution and with 1 c.c. of lymph, as the result of temporary increases in the volume of the perfusing fluid. Perfusion with as small a quantity as 0.2 c.c. of lymph has no appreciable effect.

Fig. 2.—Curve of drop rate from the same ear as in Fig. 1, later in the experiment. The constrictor effect of adrenalin is shown by the sharp decrease in drop rate, indicating the continued sensitivity of the ear preparation for as long as two hours.

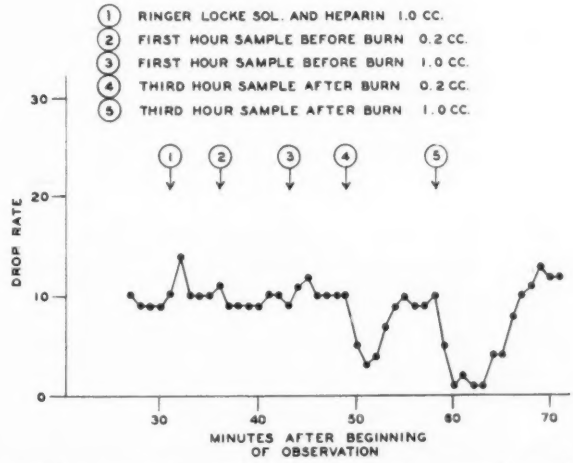

1 RINGER LOCKE SOL. AND HEPARIN 1.0 CC.
2 FIRST HOUR SAMPLE BEFORE BURN 0.2 CC.
3 FIRST HOUR SAMPLE BEFORE BURN 1.0 CC.
4 THIRD HOUR SAMPLE AFTER BURN 0.2 CC.
5 THIRD HOUR SAMPLE AFTER BURN 1.0 CC.
DROP RATE
MINUTES AFTER BEGINNING OF OBSERVATION

Fig. 3.—Illustrative curve of changes in drop rate occurring with perfusion of lymph from a burned area. Control effects are seen at *1*, *2*, and *3* similar to those shown in Fig. 1. At *4*, as little as 0.2 c.c. of lymph from a burned area causes a sharp decrease in drop rate (constrictor effect), and at *5*, a greater decrease is caused by 1 c.c.

effect regularly results from the temporarily increased volume of perfusion fluid following the injection of as little as 1 c.c. of an inert solution.

RESULTS

The results of the control observations are shown in Table I for unheparinized dogs and in Table II for heparinized dogs. In these tables

TABLE I

UNHEPARINIZED DOGS

AVERAGE CONTROL LYMPH OBSERVATIONS

	AMOUNT INJECTED (C.C.)	BASIC DROP RATE PER MIN.	PERCENTAGE CHANGE IN DROP RATE	MIN. TO RETURN TO BASIC DROP RATE	CURVE AREA (SQ. IN.)	LIMITS OF CURVE AREA RANGE (SQ. IN.)
Averages 6 dogs 32 observations	0.2	11 to 17	−6	2	− .01	+.01 to −.07
	1.0	10 to 15	+8	4	+ .01	+.09 to −.22

TABLE II

HEPARINIZED DOGS

AVERAGE CONTROL LYMPH OBSERVATIONS

	AMOUNT INJECTED (C.C.)	BASIC DROP RATE PER MIN.	PERCENTAGE CHANGE IN DROP RATE	MIN. TO RETURN TO BASIC DROP RATE	CURVE AREA (SQ. IN.)	LIMITS OF CURVE AREA RANGE (SQ. IN.)
1,000 Units Heparin Per Kilogram Body Weight						
5 dogs 19 observations	0.2	10 to 20	−17	3	−.06	+.03 to −.34
	1.0	10 to 20	− 1	5	−.09	+.11 to −.83
2,000 Units Heparin Per Kilogram Body Weight						
4 dogs 14 observations	0.2	13 to 17	+ 2	2	0	+.02 to −.02
	1.0	12 to 23	+19	4	+.05	+.12 to −.15
3,000 Units Heparin Per Kilogram Body Weight						
1 dog 2 observations	0.7	12	+16	4	+.04	----------
	1.0	12	0	0	0	----------
Averages	0.2	10 to 20	+ 1	3	−.01	+.03 to −.34
	1.0	10 to 23	+ 6	3	−.01	+.12 to −.83

the control observations include samples from control animals which were never burned, as well as samples from experimental animals obtained before burning. The average change in drop rate is small and the average curve area is practically zero in both groups, indicating that under the conditions of these experiments, lymph from normal or heparinized animals has no constrictor effect.

In the burned unheparinized dogs the average percentage change in drop rate is marked and negative, as is the change in curve area (Table III). This constrictor effect is evident in lymph collected as early as

TABLE III

UNHEPARINIZED DOGS

AVERAGE BURN LYMPH OBSERVATIONS

	AMOUNT INJECTED (C.C.)	BASIC DROP RATE PER MIN.	PERCENTAGE CHANGE IN DROP RATE	MIN. TO RETURN TO BASIC DROP RATE	CURVE AREA (SQ. IN.)	LIMITS OF CURVE AREA RANGE (SQ. IN.)
One hr. after burn 3 dogs 6 observations	0.2	10 to 14	-75	9	- .44	-.12 to - .60
	0.5 to 1.0	11 to 14	-84	33	-1.66	-.40 to -2.49
Two hr. after burn 3 dogs 12 observations	0.2	10 to 17	-29	4	- .09	-.05 to - .19
	0.5 to 1.0	10 to 16	-70	10	- .52	-.22 to -1.33

TABLE IV

HEPARINIZED DOGS

AVERAGE BURN LYMPH OBSERVATIONS

	AMOUNT INJECTED (C.C.)	BASIC DROP RATE PER MIN.	PERCENTAGE CHANGE IN DROP RATE	MIN. TO RETURN TO BASIC DROP RATE	CURVE AREA (SQ. IN.)	LIMITS OF CURVE AREA RANGE (SQ. IN.)
1,000 Units Heparin Per Kilogram Body Weight						
One hr. after burn 5 dogs 10 observations	0.2	14 to 20	-31	8	- .21	-.06 to - .41
	1.0	12 to 21	-66	21	-1.37	-.06 to -3.31
Two hr. after burn 5 dogs 16 observations	0.2	12 to 20	-29	5	- .18	0 to -1.00
	1.0	10 to 19	-37	9	- .33	0 to - .95
Three hr. after burn 4 dogs 7 observations	0.2	10 to 21	-46	9	- .65	-.04 to -2.34
	1.0	10 to 20	-50	18	- .76	-.22 to -1.84
Four hr. after burn 2 dogs 3 observations	0.2	14 to 18	-58	19	-1.56	-.09 to -3.03
	1.0	17	-47	9	- .24	----------
2,000 Units Heparin Per Kilogram Body Weight						
One hr. after burn 4 dogs 16 observations	0.2	11 to 22	-16	3	- .08	+.03 to - .34
	1.0	11 to 22	-48	7	- .28	-.04 to -1.00
Two hr. after burn 3 dogs 8 observations	0.2	11 to 23	-12	4	- .05	0 to - .10
	1.0	11 to 21	-32	9	- .21	+.07 to - .59
Three hr. after burn 1 dog 2 observations	0.2	12	-33	8	- .14	----------
	1.0	11	-81	27	-1.19	----------
3,000 Units Heparin Per Kilogram Body Weight						
One hr. after burn 1 dog 2 observations	0.7	10	-40	10	- .20	----------
	1.0	12	-41	13	- .40	----------
Two hr. after burn 1 dog 1 observation	1.0	12	-33	14	- .25	----------

one hour after burning and when as small an amount as 0.2 c.c. of lymph is injected into the perfusion fluid.

In the burned heparinized animals (Table IV) similar effects are observed although the average degree of vasoconstriction tended to be somewhat less than in the unheparinized dogs.*

No attempt was made to identify or isolate the vasoconstricting substance indicated by the results of these experiments. It was found that boiling the lymph obtained from a burned area does not destroy the constrictor agent.

SUMMARY

Evidence is presented of a vasoconstricting substance in the lymph from an experimentally burned area. It is not due to the process of coagulation since it is present when previously heparinized animals are employed. It is possible that this is the constrictor substance observed in the circulating blood by Page.[1] The substance has not been identified nor its relation to a supposed "burn toxemia" established.

I am indebted to Dr. E. M. Landis for the loan of equipment and for guidance and advice in the perfusion of the rabbit's ear.

REFERENCES

1. Underhill, F. P., and Kapsinow, R.: The Alleged Toxin of Burned Skin, J. Lab. & Clin. Med. **16**: 823-830, 1931.
   Harrison, W. G., Jr., and Blalock, A.: A Study of the Cause of Death Following Burns, Ann. Surg. **96**: 36-39, 1932.
   Barsoum, G. S., and Gaddum, J. H.: The Effect of Cutaneous Burns on the Blood Histamine, Clin. Sc. **2**: 357-362, 1935.
   Rosenthal, S. R.: The Toxin of Burns, Ann. Surg. **106**: 111-117, 1937.
   Wilson, W. C., Jeffrey, J. S., Roxburgh, A. N., and Stewart, C. P.: Toxin Formation in Burned Tissues, Brit. J. Surg. **24**: 601-611, 1937.
   Rose, B., and Browne, J. S. L.: Studies on the Blood Histamine in Cases of Burns, Ann. Surg. **115**: 390-399, 1942.
   Page, I. H.: The Occurrence of a Vasoconstrictor Substance in Blood, During Shock Induced by Trauma, Hemorrhage, and Burns, Am. J. Physiol. **139**: 386-398, 1943.
   Drinker, C. K.: Personal communication, 1943.
2. Alrich, E. M., and Lehman, E. P.: Studies on Burns, I, SURGERY **15**: 899-907, 1944.
3. Glenn, W. W. L., Peterson, D. K., and Drinker, C. K.: Flow of Lymph From Burned Tissue, With Particular Reference to the Effects of Fibrin Formation Upon Lymph Drainage and Composition, SURGERY **12**: 685-693, 1942.
4. Landis, E. M., Wood, J. E., and Guerrant, J. L.: Effect of Heparin on the Vasoconstrictor Action of Shed Blood Tested by Perfusion of the Rabbit's Ear, Am. J. Physiol. **139**: 26-38, 1943.

*A few preliminary experiments of a different type offer some confirmation of the observations recorded in this study. The mean arterial blood pressure is increased when anything is done to a burned extremity to increase the flow of lymph. A rise in blood pressure was observed to occur after confinement in plaster, after massage, and after heating of the burned foot. Each of these procedures was shown by simultaneous observations to increase lymph flow. The quantitative increase in flow is not sufficient to account mechanically for the observed increases in mean pressure, and the latter are therefore probably due to the release of an increased amount of vasoconstrictor substance.

COTTON AS A SUTURE MATERIAL

EARL O. LATIMER, M.S., M.D., F.A.C.S., CHICAGO, ILL.

(From the Division of Surgery, Northwestern University Medical School and The Department of Surgery, Wesley Memorial Hospital)

IN ORDER to be an acceptable suture material a substance should have the following qualifications: (1) nonirritating, (2) availability, (3) easily and completely sterilized, (4) easily handled, (5) good tensile strength with maintenance of tensile strength throughout the process of tissue repair, and (6) preferably inexpensive. No suture material known to us today is preferable to others in all respects.

The tissue reaction to catgut, silk, linen, and cotton has been reviewed by Meade and Ochsner[1] who have added their own experimental and clinical observations. In tissues, cotton loses 10 per cent of its tensile strength in fourteen days, catgut loses 50 to 70 per cent, and silk loses 35 per cent. These authors conclude that catgut is strong before being placed in tissue; its rate of absorption is dependent on its size, the chemicals present,[2, 3, 4] and the reactions of the host; and that it causes more tissue reaction than nonabsorbable material. Nonabsorbable sutures can be heat-sterilized, produce no allergic reaction (nylon was not investigated), and allow rapid wound healing. Silk and linen show early decrease in tensile strength as compared to cotton, but they are somewhat stronger at the time of implantation. There is less tissue ingrowth in cotton than in silk; thus, cotton is less apt to produce sinus formation in the presence of infection. These authors graded catgut, silk, linen, and cotton according to the amount and persistence of leucocytic infiltration, the amount of serum and fibrin present, the appearance time of fibroblasts, and length of time necessary to produce final healing in tissues. Accordingly, catgut, producing the most reaction and slowest healing, was graded 4, linen 3, silk 2, and cotton 1.

Recently I had an opportunity to examine a cotton surgical gauze sponge that was removed from the abdomen sixteen years after an operation. The individual threads of the gauze were by actual test nearly as strong as new cotton thread of the same size. There was remarkably little foreign body reaction, especially to the individual strands of thread in the connective tissue capsule which surrounded the sponge (See Fig. 1).

Silk and nylon have the advantage of elasticity, the strand giving slightly before it breaks, which warns that the breaking point is near.

Received for publication, Jan. 17, 1944.

However, the absence of this springiness in cotton does not permit its being tied so tightly and consequently tissue is less apt to be strangulated. Melick[5] states that nylon causes less tissue reaction than does

Fig. 1.—Photomicrograph of cotton thread in fibrous capsule surrounding surgical gauze sponge that had been in abdomen sixteen years. Note the remarkably small amount of inflammatory reaction about the strands of thread.

silk or catgut. Stainless steel wire, as advocated by Babcock[6] has been used by me, but in my hands its disadvantages outweigh its advantages as compared to either cotton or silk as a routine suture material. Silk, nylon, and stainless steel wire are not inexpensive.

Either square or triple-throw knots of silk or nylon are more apt to slip than are the same knots of cotton. This is because of their smoother surface. Localio, Casale, and Hinton[7] found that nylon sutures slipped unless tied with four knots with all throws square, and occasionally, even these sutures became untied. Mercerized cotton is smoother than plain cotton and thus the knots are more apt to slip with the former. Taylor[8, 9] states that a triple-throw knot is the safest of all simple knots and for all practical purposes it is trustworthy for all suture materials with the occasional exception of wet, plain catgut. He further states it is safest when all throws are tied square, but it is fairly reliable when two of the throws are square.

Cotton thread fulfills, to a greater degree than any other suture material, the postulates as laid down in the beginning of this communication. It is relatively nonirritating, universally available, easily sterilized by autoclaving, has a fair tensile strength which is maintained in the tissues, is easily handled once a "cotton technique" is developed, and is inexpensive. It has the disadvantage of being nonabsorbable; thus, all sutures must be interrupted and the operating time is lengthened. All men doing surgery cannot use cotton since the lower tensile strength requires gentleness, and interrupted sutures require patience. However, these requirements are virtues in surgery.

My experience with cotton extends over a period of several years and consists of a series of several hundred operations. These operations have included among many others, thyroidectomies, mastectomies, cholecystectomies, all types of gastrointestinal surgery, tendon sutures, hernia repairs, closure of abdominal incisions, and ligation of varicose veins. There was an incidence of wound infection of 1.4 per cent (See Table I). Out of this experience I have found cotton to be an excellent suture material but with some definite shortcomings. Experience has taught that it should not be used in grossly infected wounds except as fine ligatures catching only the blood vessels. This is contrary to the opinion of Meade and Ochsner.[1] Because of its lower tensile strength it is not as satisfactory as silk when used as a purse string for invaginating the appendix stump. Where a long loop of material is required in any potentially contaminated area, catgut is preferable. Cotton has not proved satisfactory for vaginal work except as fine ligatures. One should not become so enthusiastic that he adopts cotton to the exclusion of all other suture materials.

The tenets for the use of silk as laid down by Halsted[10] are: (1) use interrupted sutures only, (2) use silk no coarser than "C," (3) never

TABLE I

CASES OF PRIMARY WOUND CLOSURE WHERE COTTON HAS BEEN THE PRINCIPAL LIGATURE AND SUTURE MATERIAL

OPERATION	NUMBER OF OPERATIONS	NUMBER OF WOUNDS INFECTED	PER CENT OF WOUNDS INFECTED
Appendectomy	27	0	0
Cholecystectomy	22	1	4.5
Gastrointestinal Operations			
Gastric Resections	7	0	3.5
Gastroenterostomy	4	0	
Congenital Hypertrophic Pyloric Stenosis	8	0	
Miscellaneous	9	1	
Miscellaneous Abdominal Operations	23	0	0
Hernias			
Inguinal	60	1	1.7
Femoral	7	0	0
Umbilical and Ventral	7	0	0
Varicose Vein Ligations	63	1	1.6
Thyroidectomies	11	0	0
Breast			
Radical Mastectomies	4	0	0
Simple Mastectomies and Plastic Procedures	12	0	0
Bone-Joint and Tendon Operations	23	0	0
Total	287	4	1.4

bridge over a dead space, as a cord subtends an arc, (4) use transfixion sutures in ligation as finer material may be used this way, (5) use a greater number of fine stitches rather than a few coarse ones, and (6) avoid the combined use of silk and catgut. He also advises against the use of silk in the presence of an infection. The majority of these should be followed for cotton but transfixion sutures are not necessary, and catgut and nonabsorbable sutures may be freely mixed if a careful technique is observed. Shambaugh[11] states that catgut may act as a nidus of infection when used with silk. Meade and Ochsner[1] believe the poor results obtained from the combined use of silk and catgut are due to a nidus of infection and increased tissue reaction. While these basic factors are undoubtedly true, more important is the fact that when the two types of sutures are mixed, the technique usually used is that for catgut and not for a nonabsorbable suture. I do not hesitate to mix the two where it is considered advisable, and there have been no ill effects. For example, on occasions which are rare, where a long loop of suture is required to approximate tissues, catgut is used. This obviates the possibility of a sinus persisting until a long, infected, nonabsorbable suture is extruded. In gastrointestinal surgery, almost all surgeons combine catgut with nonabsorbable sutures.

Elkins[12] found a total of 2.1 per cent infections in clean cases where silk was used as a suture material and 9.4 per cent where catgut was used. In potentially infected cases 7.9 per cent of the patients became infected if silk was used and 21.4 per cent if catgut was used. The remarkable difference is probably not due to the suture material alone but

partially to the greater care exercised in handling tissues when the nonabsorbable material was used.

TECHNIQUE

Certain characteristics of cotton thread make it difficult to use at first. Its small size, lower tensility as compared with catgut, and its lack of elasticity all add to the difficulty of its use. However, these very factors tend to improve the surgeon's respect for tissues; he becomes a more gentle and a more anatomic surgeon. It should be emphasized that cotton or any nonabsorbable suture should not be used by the rough, careless, untidy surgeon who is always in a hurry. It is interesting to note that as one develops his technique for cotton sutures he gradually uses finer ligatures and sutures, frequently complaining that sutures are too heavy—sutures he at first considered too light to work with. Experience quickly teaches the proper tension for tying cotton, and soon the surgeon will not miss the warning give or spring to which he was accustomed with catgut, silk, and nylon.

The sizes most commonly used are No. 30, 50, and 60 for ligatures, with No. 50 used most often. For suturing peritoneum, No. 30 or 50 is used, the latter being preferred for infants and young children. For fascia, No. 30 is preferred. Sometimes, as in repair of postoperative hernias, No. 20 crochet cotton serves most satisfactorily. No. 20 crochet cotton serves in suturing the internal oblique to the shelving edge of the inguinal ligament because it has less cutting action than lighter thread, but elsewhere in the repair of an inguinal hernia, No. 30 or 50 suffices. Likewise, where a lighter ligature might cause difficulty if it breaks in the process of tying, as in ligating the cystic duct or the superior thyroid artery, No. 20 crochet cotton is chosen. Retention sutures are of this same material. More recently, in such situations, extra heavy button or carpet thread has been used. It is true this is quite heavy material, but its use here is justified, since the breaking of the ligature while tying may cause severe technical difficulties. This heavy thread has great tensility and is cut "on the knot" so that the total amount of material remaining is small. No difficulties have arisen from its use.

All sutures must be interrupted and, for ease and simplicity, sutures and ligatures of the same size are cut the same length. No. 30, 50, and 60 are cut in twelve-inch lengths, this being found the easiest to handle. No. 20 crochet cotton and the extra heavy button or carpet cotton is cut in sixteen-inch lengths. These are cut longer as they are frequently used to tie deep in the abdomen where a long ligature is a necessity. The property of cotton for contracting when sterilized requires that it be loosely wound while being autoclaved. We wind it loosely on special boards six and eight inches long, and then to secure sutures or ligatures of proper length, the thread is merely cut at one place giving strands twelve or sixteen inches long. These boards have a small transverse groove cut on one side for convenience in slipping scissors under the

wound thread to cut it (see Fig. 2). Again, it should be emphasized that the thread, because of its characteristic of shrinking when heated, must be wound loosely on the boards.

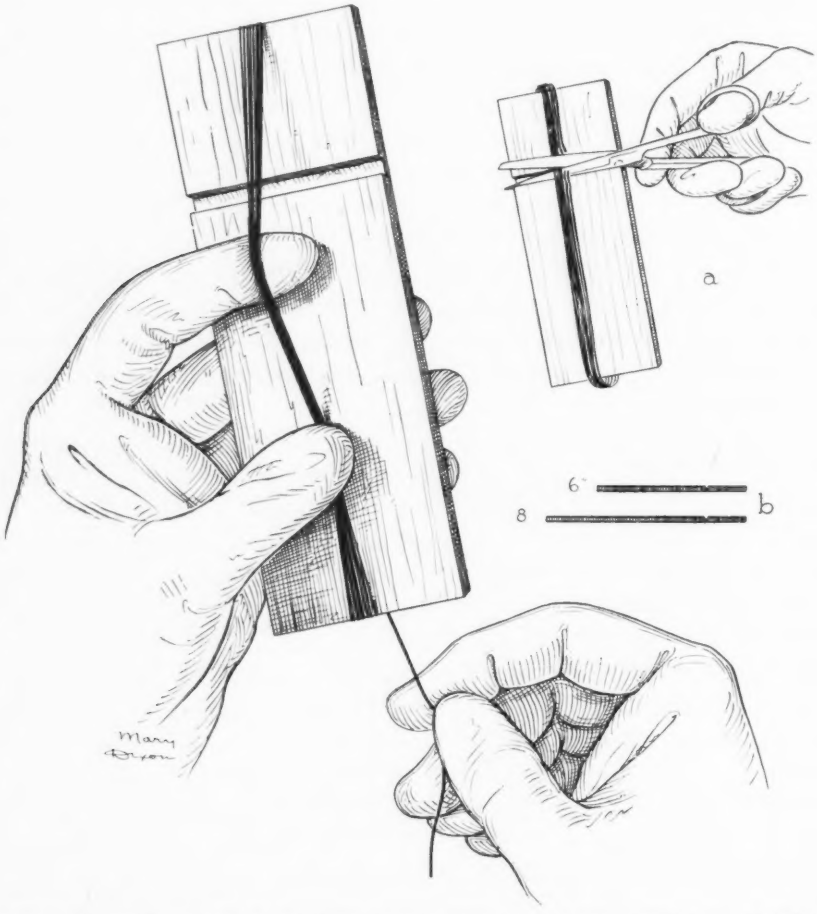


Fig. 2.—Simple method of winding thread over boards for sterilizing. Note that the thread is wound over one finger to prevent its being wound too tightly since cotton shrinks when being sterilized. All sutures are cut at one time as illustrated. No. 30, 50, and 60 cotton thread is wound over six-inch boards. No. 20 crochet and extra heavy button or carpet thread is wound over eight-inch boards, the twelve- and sixteen-inch lengths being found most convenient to handle.

Since interrupted sutures must be used, for a clean technique each suture should be carried through the tissues only once. This requires many needles to be threaded. For the larger needles this threading is simple because of the large eyes. However, as one becomes accustomed to the use of finer sutures, he begins to use finer needles, thus lessening trauma. The threading of small needles can be done rapidly only if French-eye or split-eye needles are used. The needle is held in the needle holder. One end of the suture is anchored along the shaft of the needle holder by the thumb of the hand holding this instrument. With the other hand the suture is carried across the point side of the needle,

under the tip of the needle holder and, thus being steadied, is readily pulled into the split eye of the needle (see Fig. 3). A nurse can, in the course of a few operations, become so adept at threading French-eye needles that she can keep up with the fastest surgeon by using two needle holders. While the surgeon is placing one suture, the nurse threads the second needle held in the needle holder.

Fig. 3.—Method of easily and rapidly threading French-eye or split-eye needles. Since individual sutures are used entirely, many needles must be rapidly threaded during the course of every operation.

When sewing the peritoneum and fascia in abdominal surgery or in any similar place where a layer of tissue is to be approximated, one cannot tie each suture as placed since the sutures will usually break or tear out while being tied. If all sutures are placed in the peritoneum or fascia before any are tied, and then all sutures gently lifted, the edges will be approximated and the individual sutures may be easily tied. Only small bites of tissue should be included and the sutures placed not more than 1.0 cm. apart. In order to make it easier to identify the corresponding ends of sutures after all are placed and tying is begun, we have been alternating black and white thread (see Fig. 4). All knots are triple-throw knots with all throws squared. No sutures are cut until the entire row has been tied. When placed and tied in this manner, we have not seen one instance in which a suture has broken after

being placed and tied. Except in the skin, all ligatures and sutures are cut on the knot. Thus, a minimum amount of foreign material is left in the wound.

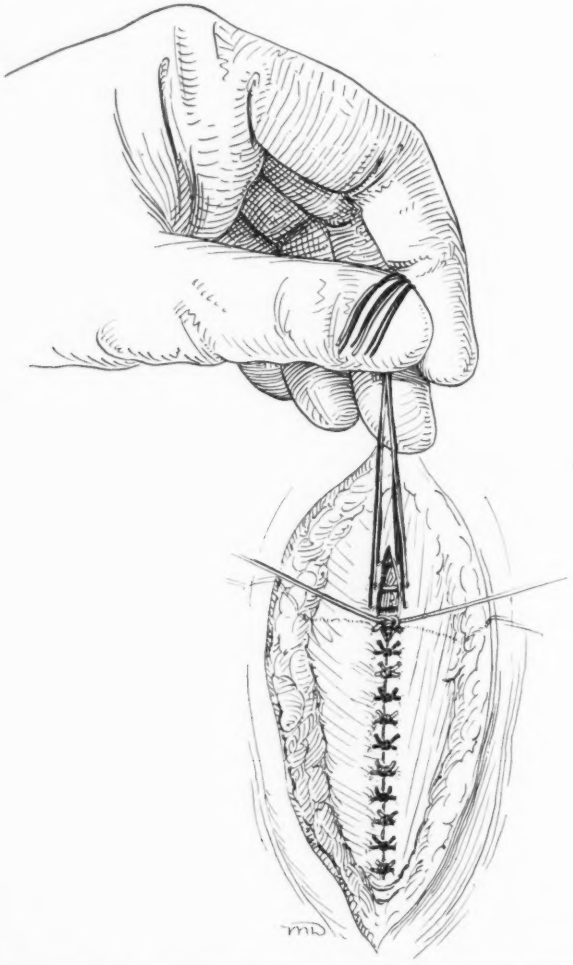


Fig. 4.—All sutures in peritoneum or fascia are placed before any are tied. Note that black and white sutures are alternated so that corresponding ends of sutures are readily identified. The sutures are cut on the knot. The entire row of sutures is tied before any are cut. For clarity of illustration, the sutures already tied have been cut in this illustration.

In wounds suspected of being contaminated, sulfonamide crystals are blown into the wound to "frost" the tissue. Also, this is done routinely in the abdominal wounds of infants and very young children. For this purpose a sterile insufflator is used.

Cotton is now used in over 90 per cent of all my surgery. I use it routinely in thyroid, breast, gastrointestinal, and biliary surgery. It is used in the closure of all abdominal wounds not grossly contaminated, herniorrhaphies, ligation of varicose veins, and all types of clean surgery. So far there has been no wound infection attributable to its use.

Black cotton is preferred to silk for skin closure. In a few grossly contaminated wounds, healing was delayed until loops of the cotton were extruded. Hence, it is no longer used in this type of case except for fine ligatures. It is never used as a continuous suture. I cannot agree with Taylor,[13] who uses only No. 24 thread and uses it as a continuous suture. He also uses this material in infected fields. Nor do I agree with Sparkman and Williams,[14] who close the peritoneum with a continuous, very fine cotton suture. The use of too fine cotton thread as a suture and not a ligature offers no advantage but has two disadvantages; namely, it is unnecessarily weak and, if too fine, has a knifelike cutting action. The finest size that will hold the tissues is used except in those instances where the cutting action of the suture is more pronounced than is desirable. A heavier suture here receives favor.

SUMMARY

Cotton thread is an excellent suture material when used in clean wounds.

Fine ligatures may be used in contaminated areas but not long loops of suture material.

A "cotton technique" must be developed to facilitate its use. The lack of springiness or stretching quality causes many ligatures to be broken at first, but this same quality prevents the tying of tissues too tightly.

No. 60, 50, and 30 thread is used as ligatures and sutures, the finer size for most ligatures, the larger size for sutures. No. 20 crochet cotton is used where heavier strands are needed as in retention sutures, with heavier, extra heavy button or carpet cotton being used in limited places.

In suturing layers of tissue as the peritoneum and fascia of the abdominal wall, all sutures of one layer should be placed before any are tied. This prevents sutures breaking or pulling out of the tissues. To facilitate the identification of each suture, alternate black and white thread is convenient.

Cotton is used to approximate all skin edges.

REFERENCES

1. Meade, W. H., and Ochsner, A.: The Relative Value of Catgut, Silk, Linen and Cotton as Suture Materials, SURGERY **7**: 485, 1940; idem: Spool Cotton as a Suture Material, J. A. M. A. **113**: 2230, 1939.
2. Dunham, C. L., and Jenkins, H. P.: Surgical Gut (Catgut) Tubing Fluid as a Tissue Irritant, Ann. Surg. **118**: 269, 1943.
3. Sidwell, A. E.: Hydrocarbon Content of Non-boilable Surgical Gut Tubing Fluids, Ann. Surg. **118**: 285, 1943.
4. Jenkins, H. P., and Dunham, C. L.: Irritant Properties of Tubing Fluid as a Factor in the Tissue Reactions Observed With Surgical Gut (Catgut), Ann. Surg. **118**: 288, 1943.
5. Melick, D. W.: Nylon Suture, Ann. Surg. **115**: 475, 1942.
6. Babcock, W. W.: Catgut Allergy With Note on Use of Alloy Steel Wire for Sutures and Ligatures, Am. J. Surg. **27**: 67, 1935.

7. Localio, S. A., Casale, W., and Hinton, J. W.: Wound Healing—Experimental and Statistical Study, Surg., Gynec. Obst. **77**: 243, 1943.
8. Taylor, F. W.: Surgical Knots and Sutures, SURGERY **5**: 498, 1939.
9. Taylor, F. W.: Surgical Knots, Ann. Surg. **107**: 458, 1938.
10. Halsted, W. S.: The Employment of Fine Silk in Preference to Catgut and the Advantages of Transfixion of Tissues and Vessels in Control of Hemorhage, J. A. M. A. **60**: 1119, 1913.
11. Shambaugh, P.: Postoperative Wound Complications. A Clinical Study With Special Reference to the Use of Silk, Surg., Gynec. & Obst. **64**: 765, 1937.
12. Elkins, D. C.: Wound Infection, Ann. Surg. **112**: 280, 1940.
13. Taylor, K. P. A.: Single Unit Cotton Thread Surgical Technique, South. Surgeon **10**: 125, 1941.
14. Sparkman, R. S., and Williams, W. H.: The Employment of Cotton Suture Material in the Field, SURGERY **11**: 698, 1942.

THE SURGICAL TREATMENT OF CARCINOMA OF THE COMMON BILE DUCT

KENNETH L. PICKRELL, M.D., AND ALFRED BLALOCK, M.D.
BALTIMORE, MD.
(From the Department of Surgery of the Johns Hopkins University and Hospital)

CARCINOMA of the common bile duct presents difficulties from the viewpoint of surgical treatment in that the operation is a rather difficult and dangerous one. On the other hand, the disease always causes death ultimately unless operative intervention is used. Furthermore, the growth by virtue of its position in a small duct produces early symptoms due to obstruction. Marshall[1] stated: "There is probably no position within the human body, outside the central nervous system, where a growth, while yet small, is heralded by more widespread symptoms, and is attended by more uniformly disastrous consequences than the lower end of the common bile duct. . . . Surgical treatment should have a favorable effect because significant symptoms bring the patient to the physician early in the course of the disease, and the tumor is small, slow growing, and late to metastasize. Obstructive jaundice usually kills the patient before the tumor itself has passed the stage of operability." Renshaw[2] stated in 1922 that, "If it were not for hemorrhage, malignant conditions of the biliary ducts, being as a rule small, limited within the walls of the bile ducts, and late to metastasize, should lend themselves readily to surgical treatment." Recent advances in knowledge of the mechanism and control of bleeding in association with jaundice make for a more hopeful outlook.

The incidence of metastases will naturally depend somewhat upon the stage of the disease at which examinations are made. Dick[3] reported the results of post-mortem examinations of 13 patients with carcinoma of the lower end of the common duct. He stated: "In eleven out of thirteen cases at the lower end of the bile duct, there was no extension of the tumor growth beyond the wall of the bile duct, and no secondaries were found in lymphatic glands or other tissues. . . . Local extension and secondary growths in this type of cancer were thus unusual—a fact that has attracted the attention of others (Renshaw, Hunt, and Budd) and is one of the chief indications for attempting surgical removal when this condition is suspected." Metastases were found in 12 of 49 cases of carcinoma of the extrahepatic bile ducts reported by Marshall.[1] The liver was involved in 9 cases, the regional nodes in 5, the pancreas

Received for publication, Jan. 20, 1944.

in 3, and the lungs in 1 case. Kirshbaum and Kozoll[4] found a high incidence of metastases but most observers support the view that they occur late and infrequently.

Carcinoma of the extrahepatic bile ducts is not a rare lesion. In the study of Kirshbaum and Kozoll,[4] carcinoma of the extrahepatic bile ducts was noted more frequently than carcinoma of the head of the pancreas. These authors report that a total of 1,808 malignant tumors was found in 13,300 autopsies at the Cook County Hospital. Among the malignant tumors there were 55 carcinomas of the gall bladder (3 per cent of total) and 62 carcinomas of the extrahepatic bile ducts (3.4 per cent of total). In 4,239 consecutive autopsies at the Glasgow Royal Infirmary[3] there were 20 patients with carcinoma of the gall bladder and 18 with carcinoma of the biliary ducts. Gallstones are found in the majority of instances of carcinoma of the gall bladder whereas they occur relatively infrequently in association with carcinoma of the bile ducts.

A comparison of the relative frequency of malignant tumors in the different parts of the extrabiliary ducts is of interest. In Rolleston and McNee's[5] series of 92 cases, 23 were in the hepatic ducts, 6 in the cystic, 28 at the junction of the cystic, common, and hepatic ducts, and 35 in the common duct. In 62 cases reported by Kirshbaum and Kozoll,[4] 13 involved the hepatic ducts, 7 the cystic duct, 32 the common duct, and in 10 the location was the papilla of Vater. Marshall[1] reported a total of 49 cases. The lesions were located in the hepatic ducts in 7 cases, the cystic duct in 5, the junction of the hepatic, cystic, and common ducts in 11, the common duct in 11, and the ampulla of Vater in 15 cases. Since involvement of the hepatic ducts presents the greatest difficulties in surgical treatment, it is fortunate that the incidence of lesions in this location is not very high.

The literature on the operative treatment of carcinoma of the periampullar region of the duodenum was summarized by Cohen and Colp[6] in 1927, and by Whipple, Parsons, and Mullins[7] in 1935. The latter authors found a total of 80 cases. The operative procedures which were used were as follows: (1) Transduodenal excision in 65; (2) resection of the duodenum in 6; (3) retroduodenal excision in 3; (4) resection of the common duct in 3; and (5) resection of the duodenum and pancreas with closure of the pancreatic duct in 3. Regarding the end results, Whipple and his associates[7] stated: "Thus out of a total of 80 cases, 28, or 35 per cent, died an operative death, and 20 others, or 24.6 per cent, are known to have had recurrence. It is probable that many of the remaining 34 cases also died of cancer, since only a short follow-up is available in the majority." In contrast to the small number of really radical operations which had been performed previously, Whipple[8] found that 64 pancreaticoduodenectomy operations were carried out between 1935 and April 1, 1942. The site and nature of the

lesions were as follows: (1) Carcinoma of the ampulla in 21; (2) carcinoma of the pancreas in 27; (3) carcinoma of the duodenum in 9; (4) carcinoma of the common duct in 5; (5) sarcoma of the duodenum in 1; and (6) pancreatitis in 1. The mortality rate associated with these operations was 31 per cent.

It is sometimes very difficult to tell whether a carcinoma which is located in the periampullar region arose within the ampulla of Vater or in the terminal part of either the common bile duct or the pancreatic duct. Since the treatment of these lesions by radical surgery is becoming generally accepted, it usually makes little difference from the practical surgical viewpoint as to the exact point of origin. However, if the lesion is situated in the common duct at a sufficient distance from the ampulla to allow local resection, it is important to recognize this fact since the head of the pancreas and the duodenum need not be sacrificed. One of our two cases falls into this category. The lesion in the second case was limited to the terminal part of the common duct, the ampulla not being invaded, but it was not at a sufficient distance from the ampulla to allow a local resection. The description of these two cases follows.

CASE REPORTS

CASE 1.—J. E., a 60-year-old white man, a coal dealer, entered the Johns Hopkins Hospital July 29, 1942. He had enjoyed excellent health except for a single attack of pain in the right upper quadrant six years previously. This attack was associated with jaundice which lasted about two weeks.

Illness Upon Admission.—Four to six weeks prior to admission the patient first noticed that he was jaundiced. The jaundice increased with great rapidity. It was associated with pruritus, clay colored stools, dark urine, and anorexia but no pain. He had lost about fifteen pounds in weight.

Physical Examination.—The patient was 5 feet 5 inches tall and weighed 160 pounds. The skin and mucous membranes were deeply jaundiced. He was in no distress except for generalized itching, and as evidence of this there were numerous scratch marks over the body, especially around areas of psoriasis which had been present for many years. The heart was enlarged, the lungs were clear. The blood pressure was 125 systolic and 75 diastolic. The abdomen was obese and protuberant. Although the liver was not tender, it was enlarged two fingerbreadths below the right costal margin. No other organs or masses could be palpated. Rectal and neurologic examinations were negative.

Laboratory Tests.—The serologic test for syphilis was negative. The leucocyte count was 6,900 and the hemoglobin content was 97 per cent. The urine contained large amounts of bile; the stools contained no bile or blood. The icteric index was 100; the van den Bergh test showed 22 mg. per cent of bilirubin on direct reaction; the prothrombin time was 18 seconds as compared with a control test of 15 seconds.

Operation.—Exploratory laparotomy was done, resection of the common duct, choledochoduodenostomy, and cholecystectomy.

A provisional diagnosis of carcinoma of the head of the pancreas had been made by most observers. July 29, 1942, under gas-oxygen-ether anesthesia, a right subcostal incision was made. Bleeding was not excessive in spite of the deep icterus.

The liver was slightly enlarged but contained no metastases. The gall bladder was small, collapsed, thickened, and indurated; it contained no calculi. A small cord-like cystic duct entered a tremendously dilated common duct which was almost the size of the duodenum. Lemon colored bile was aspirated from it. About 1 cm. from the ampulla of Vater was an indurated mass in the lumen of the common duct which was about the size of a marble. Since the pancreas was normal, we knew that we were dealing with either an impacted calculus or a tumor of the common duct. Sutures were placed in the dilated common duct, after which it was opened (See Fig. 1). Several hundred cubic centimeters of lemon yellow bile gushed out under pressure.

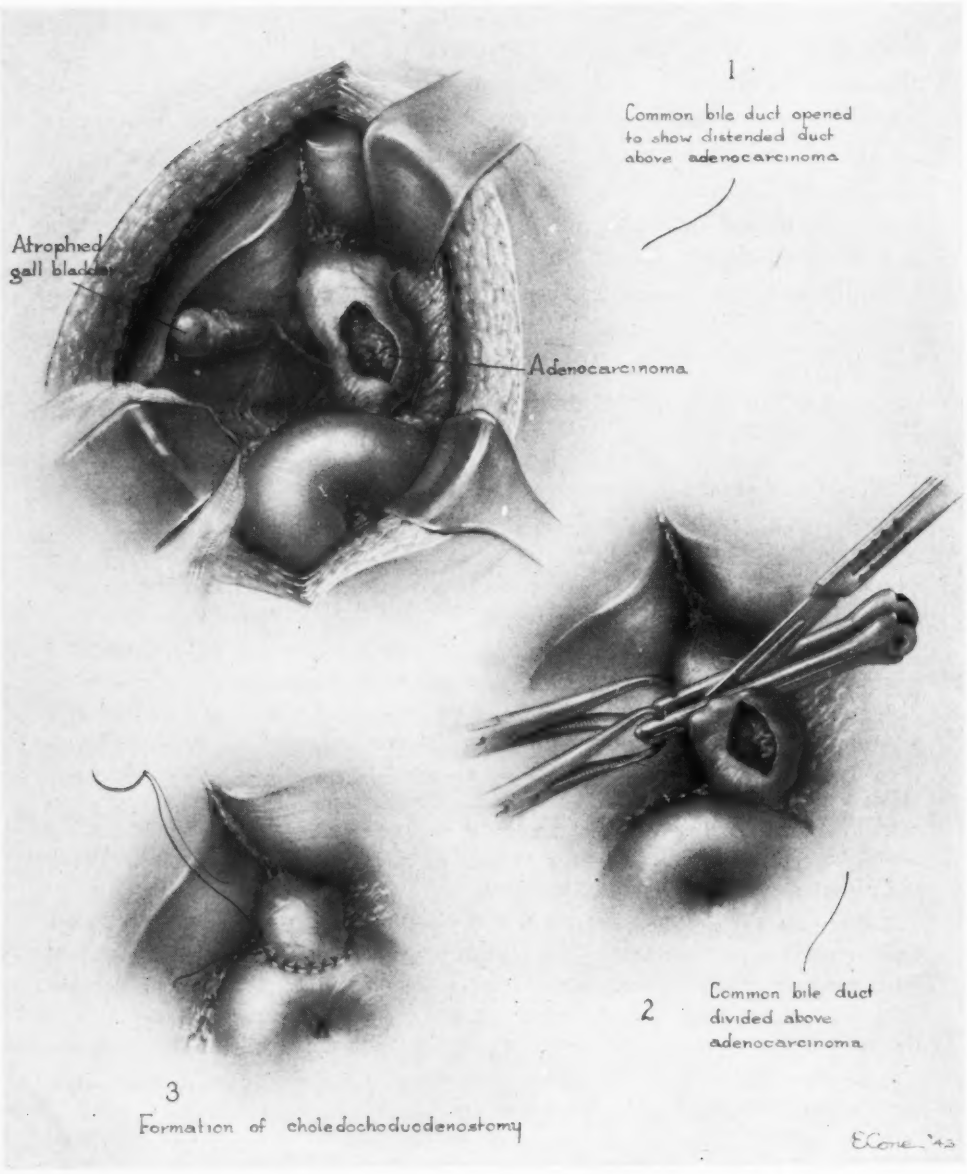
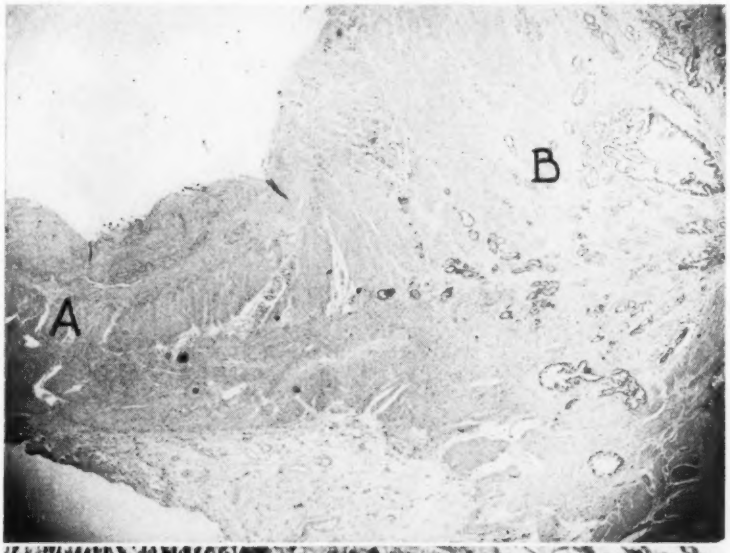


Fig. 1.—Showing the operative procedure which was performed on the first patient.

The tumor was situated 1.5 to 2 cm. from the ampulla, and was slightly more than 1 cm. in diameter. It had invaded almost the entire circumference of the duct, which at this point was greatly thickened and covered with exudate. Examination by frozen section confirmed the diagnosis of adenocarcinoma. Thereupon, the common duct was resected distally just above the ampulla and proximally 2 cm. above the growth just above the entrance of the cystic duct, which was represented only by a fibrous cord and was completely occluded. The resected portion of the common duct containing the tumor measured slightly more than 4 cm. in length (see Fig. 1).



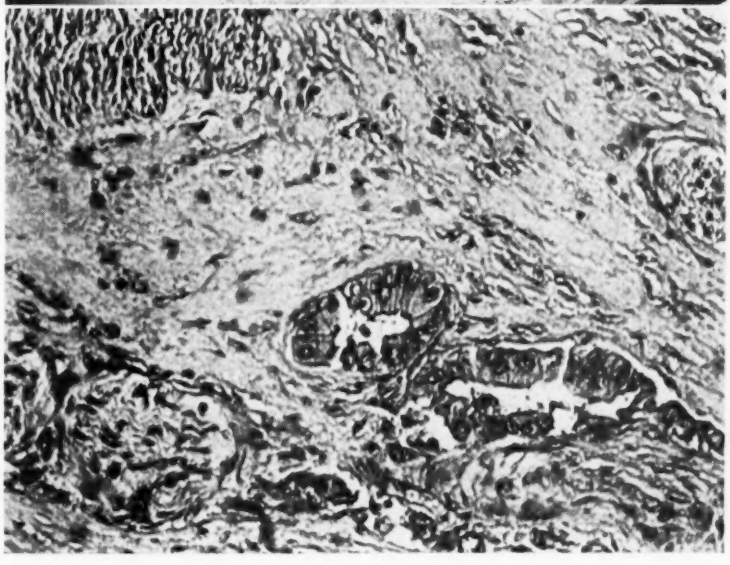


Fig. 2.—Low-power photomicrograph showing normal common duct (*A*) and adenocarcinoma of common duct (*B*). The acini are seen to grow irregularly in size and shape. This large growth by virtue of its position in a small duct produces early symptoms due to obstruction.

Fig. 3.—High-power photomicrograph of adenocarcinoma of common duct (Fig. 2*B*). The cells are irregular in size, shape, and staining quality. At the bottom of the photograph, the cells, instead of growing in the acini, are separate and are infiltrating deep into the wall of the common duct. Numerous mitotic figures are present.

Having mobilized the duodenum and the common duct, we performed a choledochoduodenostomy; a two-layer anastomosis was carried out with a continuous suture of catgut for the inner row and interrupted intestinal sutures of fine silk for the anterior and posterior rows (see Fig. 1). The region of the anastomosis was drained, and the abdominal wall was closed in layers with interrupted sutures of silk. The patient received a blood transfusion during the operation.

Fig. 4.—Photograph of 60-year-old white man (Case 1), one and one-half years after excision of an adenocarcinoma of the common duct followed by choledochoduodenostomy. The patient returned to work two months after discharge from the hospital and has been entirely well since that time.

Pathologic Specimen.—The resected portion of the common duct containing the tumor measured 4 cm. by 2 cm. by 1.5 cm. Near the distal end there was a nodule slightly more than 1 cm. in diameter growing from the wall of the duct, which itself was thickened and covered with exudate. The gall bladder was small and thickened; at the ampulla there was marked narrowing and the cystic duct was represented by only a cordlike structure.

The *histologic sections* through the tumor and the common duct showed a definite adenocarcinoma of the common duct. The acini were growing irregularly and gave definite evidence of anaplasia. The cells were irregular in size, shape, and staining quality. Numerous mitotic figures were present. In some areas the cells, instead of growing in the acini, were separate and were growing in strands and infiltrated deep into the tissue. In other areas the acini formed by the tumor tissue resembled more closely those seen in normal mucosa (see photomicrographs, Figs. 2 and 3).

The gall bladder showed evidence of chronic inflammation. The mucosa was intact and showed no evidence of metaplasia or anaplasia.

Postoperative Course.—The patient's postoperative course was complicated by cardiac decompensation, pneumonia, and a wound infection due to *Staphylococcus aureus.* The highest temperature recording was 101° F. He was treated with sulfadiazine and digitalis. Bile appeared in the stool on the fifth postoperative day, and during this period the bilirubin as shown by the van den Bergh test fell from 22 to 14 mg. per cent. The jaundice continued to subside and at the time of discharge, six weeks after operation, had disappeared. The bilirubin was 1 mg. per cent.

Subsequent Course.—During the one and one-half years since discharge from the hospital the patient has had excellent health, has gained twenty-five pounds in weight, has regained his normal vigor, and has returned to work as a salesman. As shown in a recent photograph he appears to be in excellent health (see Fig. 4).*

CASE 2.—H. P., a 67-year-old Negro man was admitted to the Johns Hopkins Hospital May 7, 1943. He was a retired mail truck driver and had enjoyed excellent health until about three months prior to admission, when he first noticed eructation and flatulence after meals. These symptoms had persisted with increasing severity and on several occasions had been associated with vomiting. Generalized itching and jaundice had been present for almost a month prior to admission. During this latter period urine had been dark and stools clay colored. He had no pain or discomfort. Progressive anorexia was associated with a loss in weight of about fifteen pounds.

Physical Examination.—The patient was 5 feet 8 inches tall and weighed 135 pounds. He appeared chronically ill. There was evidence of considerable recent loss in weight as the skin was dry and wrinkled. The mucous membranes were deeply jaundiced. The lungs were clear; the heart was slightly enlarged to the left. The blood pressure was 144 systolic and 76 diastolic. The abdomen was slightly full and was tympanitic. The liver was enlarged three fingerbreadths below the right costal margin. There was some tenderness on deep palpation in the epigastrium and right hypochondrium, although no masses could be felt. The remainder of the examination was essentially negative.

Laboratory Tests.—The serologic test for syphilis was negative. The leucocyte count was 5,280. The hemoglobin content was 11.9 Gm. (82 per cent). The van den Bergh test showed a direct reaction of 22 mg. per cent. The icteric index was 80. The urine contained bilirubin and urobilin. The stool contained no bile and no blood.

Operation.—First Stage: Exploratory laparotomy was done, and cholecystogastrostomy.

At the time of the first operation, May 10, a right subcostal incision was made. The liver was enlarged three fingerbreadths beneath the costal margin. It contained no metastases. The stomach and duodenum were normal. The gall bladder was greatly distended and its walls were markedly thickened; it could not be emptied except by aspiration, which yielded green-black viscous bile. No calculi could be palpated after aspiration. The cystic duct was moderately dilated; the common duct was greatly distended. No enlarged glands were present. In the distal end of the common duct one could feel a dime-sized indurated nodule which was interpreted as being a carcinoma of the distal end of the common duct or the ampulla of Vater. There was a small area of localized induration in the head of the pancreas. The patient's general condition at this time did not permit an extensive resection, and therefore a cholecystogastrostomy was performed.

Postoperative Course.—Following the first operation the jaundice almost immediately began to subside and within three weeks had disappeared. The patient

*This patient returned recently with symptoms and findings suggestive of a recurrence.

was up and around the ward within ten days, and his general condition so rapidly improved that he hesitated to consent to a second operation.

Operation.—Second Stage: Exploratory laparotomy was done and a modified Whipple operation with resection of the duodenum, pancreas, and common and pancreatic ducts. The common duct was ligated and the pancreatic duct was transplanted into the duodenum. Posterior gastroenterostomy was carried out.

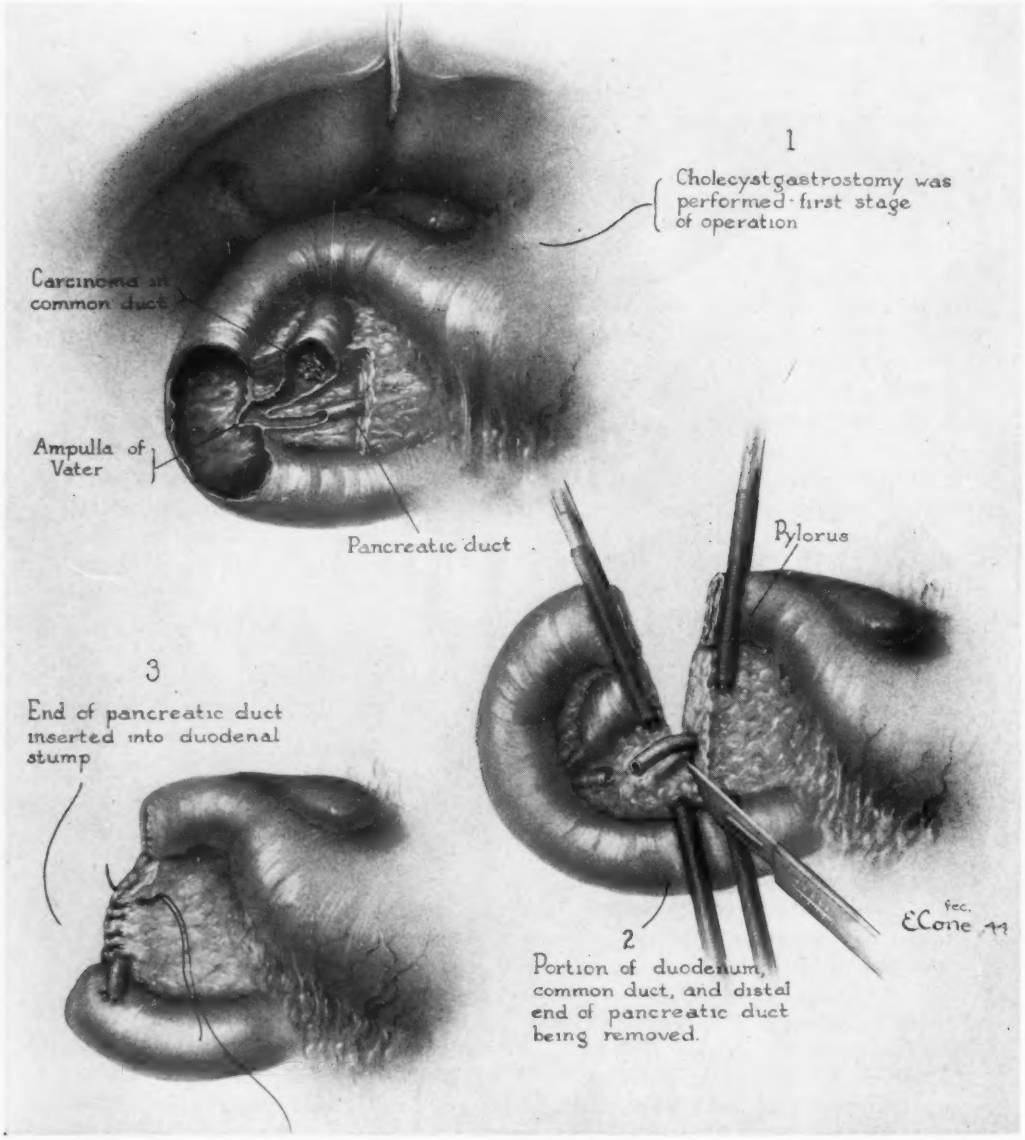


Fig. 5.—Showing the operative procedure which was performed on the second patient.

June 3, under gas-oxygen-ether anesthesia, a transverse incision was made at the level of the previous subcostal incision. Many adhesions were present, especially between the duodenum and the transverse colon. The cholecystogastrostomy admitted two fingers. The duodenum was resected just distal to the pylorus and the proximal

stump was inverted. The duodenum was then resected between Stone clamps about 6 cm. below the level of the ampulla. The head of the pancreas, together with the duodenum, was mobilized. The pancreas was divided at the junction of the head and body. The main pancreatic duct, which was dilated, was divided somewhat proximal to the remainder of the pancreas in order that it could subsequently be implanted into the duodenum. The common duct was resected about midway between the entrance of the cystic duct and the ampulla. The stump was closed with multiple interrupted sutures of silk. The pancreatic duct was then implanted into the side of the duodenum (see Fig. 5). The end of the duodenum was closed in

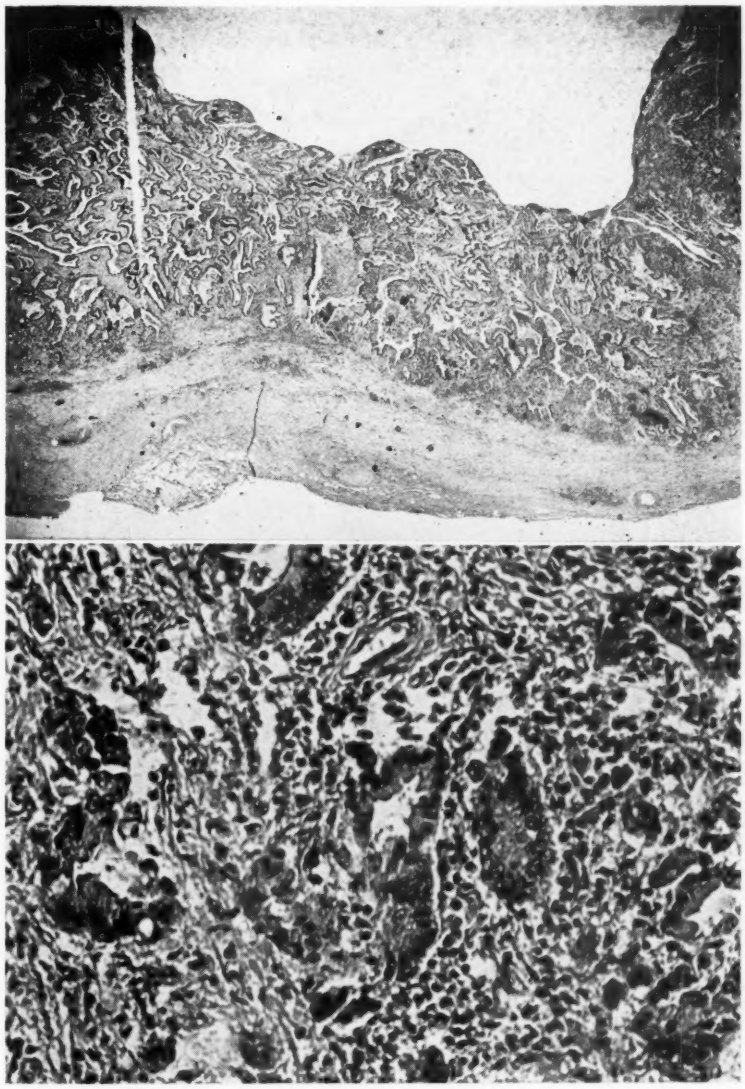


Fig. 6.—Low-power photomicrograph of histologic section from Case 2, showing the diffuse involvement of the lower end of the common duct by a mucous-forming adenocarcinoma. This neoplastic process was confined to the distal part of the common duct while the ampulla, duodenum, and pancreas were normal.

Fig. 7.—High-power photomicrograph showing mucous-forming adenocarcinoma of the common duct. The acini are seen to grow irregularly in size and shape, and form large quantities of mucus. Numerous mitotic figures are present.

layers. A posterior gastroenterostomy was performed between the jejunum and the posterior surface of the stomach. Five grams of sulfanilamide were placed in the peritoneal cavity, after which the abdominal wall, which was drained, was closed in layers with interrupted sutures of silk.

Pathologic Report.—The gross specimen showed a tumor which arose from the wall of the common duct just above the ampulla of Vater. Although the ampulla itself was normal, its opening was completely occluded by the tumor, producing distention of both the common duct and the pancreatic ducts. The histologic examination showed a mucous-forming adenocarcinoma arising in and confined to the distal part of the common duct (see Figs. 6 and 7). The pancreas, ampulla, and duodenum were normal.

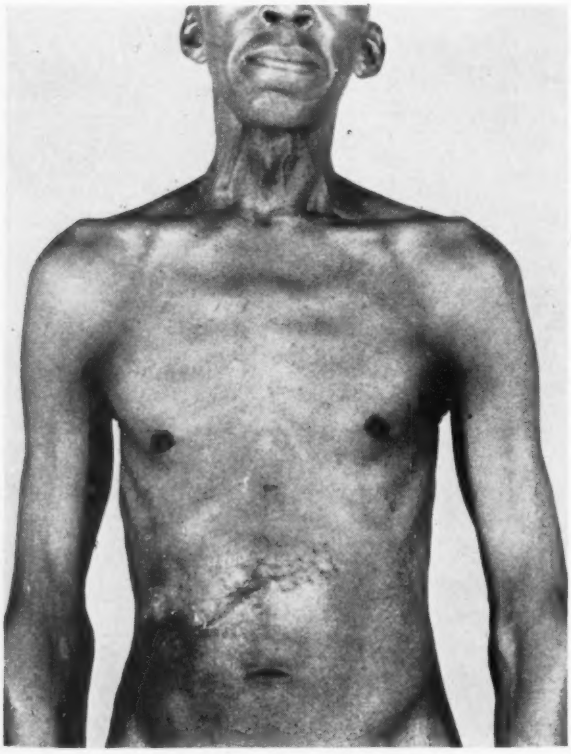


Fig. 8.—Photograph of 67-year-old colored man (Case 2) six months following a modified Whipple operation (pancreatoduodenectomy with implantation of the pancreatic duct into the duodenum). The patient is in excellent health. There has been no evidence of disturbed fat metabolism.

Postoperative Course.—After this extensive operation the patient's temperature ranged between 99 and 100.4° F. for ten days and then remained at normal. His general condition was always good. At the end of the first week a draining sinus developed in the wound from which exuded large quantities of fluid, tests of which showed the presence of trypsin. Serum lipase levels, however, were always within normal limits. The drainage decreased progressively and entirely ceased after five weeks. When the patient was discharged from the hospital, six weeks after the second operation, the incision was firmly healed, his appetite was excellent, his strength good, and he had a subjective feeling of well being which has persisted. A photograph of the patient is shown in Fig. 8.

DISCUSSION

Most of the operations for the treatment of carcinoma of the lower end of the common bile duct have consisted of transduodenal local excision. The exact point of origin of the tumor as observed or palpated at the time of operation has remained undetermined in many cases. Furthermore, the removal of a malignant tumor in the region of the ampulla by the transduodenal route would not appear to be the manner in which cancer should be attacked. For these reasons and others, discussion will be limited to proved tumors of the common duct in which the operative treatment consisted either in resection of the common duct itself or pancreaticoduodenectomy. The cases which fall into this category are listed in Table I. This table is a revision and extension of cases collected by Stewart, Lieber, and Morgan.[9]

The most recent case reported was that of Dragstedt and his associates.[27] A pancreaticoduodenostomy with implantation of the hepatic duct into the stomach was performed in one stage. A duodenal fistula developed after two weeks, and the patient's subsequent course was characterized by progressive nutritional impairment with death ensuing four months after operation. At autopsy the pancreatic duct was found to be completely occluded and was dilated while the pancreas was atrophied and fibrotic. The atrophy, however, was limited to the acinar tissues while the islets were normal. Dragstedt raised the question, "Should not the pancreatic duct be reimplanted into the intestine in this operation?" In our second case the pancreatic duct was implanted into the duodenum. It is Dragstedt's opinion that complete removal of pancreatic digestion by ligation of the pancreatic ducts produces an additional handicap to adequate nutrition.

The successful removal of large portions of the pancreas, together with the ducts, has been reported by various authors.[28, 29, 30, 33] The experience of investigators (Whipple, Dragstedt, Harvey, Oughterson, Brunschwig) has modified some of the established concepts of the physiology of the pancreas, and particularly concepts regarding the indispensability of the external secretions of the pancreas. In Case 1 in Harvey and Oughterson's series,[30] in which all but a small fraction of the pancreas was removed, the patient gained weight, did not develop diabetes, and there was no evident disturbance of fat metabolism. In Case 6, however, in which a subtotal pancreatectomy was also performed, the patient developed severe and persistent diabetes, avitaminosis, and presented the classical symptoms of voluminous, frothy, offensive stools usually associated with pancreatic deficiency. It is not clear why some patients have the typical fatty diarrheal stools, while other patients with a similar amount of pancreas removed have no obvious abnormality of fat embolism. Brunschwig[33] feels that "successful anatomic implantation of the pancreatic stump into the bowel in

TABLE I

ATTEMPTS AT SURGICAL REMOVAL OF CARCINOMA OF THE COMMON BILE DUCT

YEAR	AUTHOR	OPERATION	RESULT
1902	Uliszewski[10]	Resection of gall bladder, cystic duct, and common duct; drainage of hepatic duct	Patient died 3 days after operation
1903	Kehr[11]	Resection; cholecystectomy; hepaticoduodenostomy	Patient died 27 mo. after operation
1909	Morian[12]	Resection; cholecystoduodenostomy	Patient died 10 mo. after operation
1911	Spindler[13]	Resection; cholecystectomy; reconstruction of common and hepatic ducts	Patient died 7 days after operation
1912	Laméris[14]	11/23/07: Resection; cholecystectomy; drainage of hepatic duct 8/27/08: Resection of recurrent lesion; partial excision of liver; drainage of hepatic duct	Patient died 8 mo. after second operation
1920	Pallin[15]	Resection; hepaticoduodenostomy	Patient died 11 mo. after operation
1922	Renshaw[2]	Choledochotomy; cholecystectomy with removal of all the cystic duct and part of the common duct; plastic on common duct	Result unknown
1922	Renshaw[2]	Excision of growth of common duct with end-to-end anastomosis	Result unknown
1923	Nyström[16]	Resection of common and hepatic ducts; removal of gall bladder; end-to-end anastomosis of duct	Died one year later; no metastases
1923	Prat[17]	Resection; hepaticoduodenostomy	Patient died several hours after operation
1928	Plivèric[18]	Resection	Patient died 10 days after operation
1935	Demel[19]	Resection; subserous cholecystectomy; hepaticoduodenostomy; anastomosis of cut ends of ducts	Patient died 7 mo. after operation
1936	Quénu and Gasne[20]	Resection; hepaticoduodenostomy	Patient died 12 mo. after operation
1939	Garlock[21]	Segmental resection of upper common, lower hepatic ducts with inclusion of tumor, cystic duct, and gall bladder; end-to-end anastomosis of common duct	Living and essentially well 5 yr. after operation
1940	Walters, W., and Snell[22]	Resection, anastomosis of cut ends	Died 8 days after operation, bronchopneumonia
1941	Brunschwig and Clark[23]	Pancreatoduodenectomy, one stage	Patient died 2 days following operation; aspiration pneumonia (?)
1941	Brunschwig and Clark[24]	Pancreatoduodenectomy, one stage with drainage of transected common duct to exterior	Patient died 3 mo. and 6 days after first operation, 16 days after second operation (peritonitis) performed for anastomosis of gall bladder to jejunum
1942	Gordon-Taylor[25*]	Local removal of tumor of common duct; closure of opening duct; cholecystogastrostomy	Patient died one year after operation

*Gordon-Taylor refers to two patients operated upon by Sir James Walton, but designated article does not describe these.

TABLE I—CONT'D

YEAR	AUTHOR	OPERATION	RESULT
1942	Kindersley[26]	Resection at junction of cystic and common ducts	Surviving several years
1943	Dragstedt et al.[27]	Pancreatoduodenectomy; implantation of hepatic duct into stomach	Died 4 mo. after operation from cachexia
1942	Pickrell and Blalock	Resection of common duct; removal of gall bladder; choledochoduodenostomy	18 mo. following operation, condition excellent
1943	Pickrell and Blalock	Cholecystogastrostomy; removal of part of duodenum, head of pancreas, and terminal common duct; gastroenterostomy; implantation of pancreatic duct into duodenum	7 mo. after operation, condition good

*Cattell recently reported a case of primary carcinoma of the bile ducts in which partial resection of the common hepatic and common bile duct and cholecystectomy were performed, and an end-to-end anastomosis was carried out.[34]

man has not yet been demonstrated to afford normal or appreciable secretion of pancreatic juice into the bowel,'' and he, therefore, ''continues to occlude the transected pancreatic stumps until evidence is presented that external pancreatic secretion may be restored by implantation procedures.'' However, there are a number of experimental observations which may be cited to explain the variable response of depancreatized patients. It is well known that pancreatectomy in different species of animals results in different degrees of disturbed carbohydrate metabolism. There is evidence that this is in part due to the different activity of the pituitary and adrenal glands. In man the high incidence of glycosuria in acromegalic persons is well known. Thus, as stated by Waters and Best,[32] the diabetic state may not be due primarily to subnormal secretion of antidiabetic hormone but to various other hormonal disturbances, especially of the pituitary and adrenals.

The evidence of deranged *fat metabolism* also presents a similar variability. There are now a number of living patients who have survived a subtotal pancreatectomy,[28-31] and who have no obvious evidence of disturbed fat metabolism. In some of these patients there seems to be no doubt that the external secretions of the pancreas do not reach the intestine. One may infer, therefore, that the external secretions of the pancreas are not absolutely essential to life in all instances. However, as additional patients are studied and operated upon, new facts will be gleaned, for it is already known that some of the enzymatic functions of the external secretions of the pancreas may be carried out at least partially by other parts of the gastrointestinal tract. However, it is the opinion of most observers that whenever it is possible, pancreatic secretions should be preserved by implantation of the pancreatic duct into the intestine.

Cancer of the extrahepatic biliary system, the pancreas, and ampullary region may well be considered as an entity since it is frequently

impossible clinically to determine the exact site or origin of the tumor. The position or extension of these tumors makes it imperative for one dealing with this type of patient to be familiar with, and capable of executing, radical excisions of the extrahepatic biliary ducts, the duodenum, and the pancreas and then to restore the physiology of the patient to as nearly normal as possible, granting that the treatment or disposition of the bile and pancreatic ducts has yet not been clearly established, and that the surgical technique is still in the experimental stage.

SUMMARY

The surgical treatment of carcinoma of the common bile duct is considered. It is emphasized that the growth by virtue of its position produces obstructive symptoms early in the course of the disease and that complete extirpation is frequently possible before extension and metastases have occurred. Excluding those instances in which transduodenal excision was employed, the literature dealing with the removal of common duct tumors is reviewed. The history, findings, and the operative procedures in two of our patients are outlined in detail.

REFERENCES

1. Marshall, J. M.: Tumors of the Bile Ducts, Surg., Gynec. & Obst. **54**: 6, 1932.
2. Renshaw, K.: Malignant Neoplasms of the Extrahepatic Biliary Ducts, Ann. Surg. **76**: 205, 1922.
3. Dick, J. C.: Carcinoma of the Lower End of the Common Bile Duct, Brit. J. Surg. **26**: 757, 1938-39.
4. Kirshbaum, J. D., and Kozoll, D. D.: Carcinoma of the Gall Bladder and Extrahepatic Ducts, Surg., Gynec. & Obst. **73**: 740, 1941.
5. Rolleston, H., and McNee, J. W.: Diseases of the Liver, Gall-Bladder and Bile-Ducts, Ed. 3, New York, 1929, The Macmillan Company.
6. Cohen, I., and Colp, R.: Cancer of the Peri-Ampullary Region of the Duodenum, Surg., Gynec. & Obst. **45**: 332, 1927.
7. Whipple, A. O., Parsons, W. B., and Mullins, C. R.: Treatment of Carcinoma of the Ampulla of Vater, Tr. Am. S. A. **53**: 282, 1935.
8. Whipple, A. O.: Discussion of paper of Oughterson and Harvey, presented at meeting of American Surgical Association in 1942, Ann. Surg. **115**: 1085, 1942.
9. Stewart, H. L., Lieber, M. M., and Morgan, D. R.: Carcinoma of the Extrahepatic Bile Ducts, Arch. Surg. **41**: 662, 1940.
10. Uliszewski, H.: Ueber primäres Carcinoma der Gallengänge, Greifswald, 1902, H. Adler.
11. Kehr, H.: Ein Fall von ausgedehnter Resektion des Ductus choledochus und hepaticus wegen Carcinoma choledochi mit nachfolgender Ektomie der Gallenblasse und Hepatiko-Duodenostomie, München. med. Wchnschr. **50**: 101, 1903.
12. Morian, R.: Ueber das Choledochuscarcinom an der Papilla Vater, Deutsche Ztschr. f. Chir. **98**: 366, 1909.
13. Spindler, R.: Zur Chirurgie des Choledochuskrebses, Wien. klin. Wchnschr. **24**: 936, 1911.
14. Laméris, H. J.: Hepato-cholangio-Enterostomie, Zentralbl. f. Chir. **39**: 1665, 1912.
15. Pallin, G.: Das Carcinom des Ductus hepaticocholedochus und seine chirurgische Behandlung, Beitr. z. Klin. Chir. **121**: 84, 1920; **121**: 68, 1920.
16. Nyström, G.: A Case of Cancer in the Gall Ducts and Resection With Good Result, Acta chir. Scandinav. **56**: 85, 1923.
17. Prat, D.: Dos casos de cáncer de las vías biliares principales, An. Fac. de med. de Montevideo **8**: 291, 1922-23.

18. Plivèric, V.: Klinischer Beitrag zu den Karzinomen des Confluens ductum, Zentralbl. f. Chir. **551**: 133, 1928.
19. Demel, R.: Beitrag zur Resektion des Ductus hepaticus und choledochus wegen Carcinoms, Arch. f. klin. Chir. **182**: 148, 1935.
20. Quénu, J., and Gasne, P. G.: L'exerèse du cancer hépato-cystique, Bull. méd., Paris **50**: 439, 1936.
21. Garlock, J. H.: Primary Carcinoma of Common Bile Duct. Resection, End-to-End Anastomosis, Ann. Surg. **100**: 474, 1939.
22. Walters, W., and Snell, A. M.: Diseases of the Gall Bladder and Bile Ducts, Philadelphia, 1940, W. B. Saunders Company, p. 475.
23. Brunschwig, A., and Clark, D. E.: Carcinoma of Intrapancreatic Portion of Common Bile Duct, SURGERY **10**: 553, 1941.
24. Brunschwig, A., and Clark, D. E.: Carcinoma of Cystic Duct; Report of Case and Comments on Ligation of Hepatic Artery in Man, Arch. Surg. **42**: 1094, 1941.
25. Gordon-Taylor, G.: Radical Surgery of Cancer of Lower End of Common Bile Duct and Adjacent Pancreas (Hunterian Lecture), Brit. M. J. **2**: 119, 1942.
26. Kindersley: quoted by Gordon-Taylor.[25]
27. Dragstedt, L. R., Julian, O. C., Allen, J. G., and Owens, F. M.: Implantation of the Hepatic Duct Into the Duodenum or Stomach, Surg., Gynec. & Obst. **77**: 126, 1943.
28. Hunt, V. C.: Surgical Management of Carcinoma of the Ampulla of Vater and of the Periampullary Portion of the Duodenum, Ann. Surg. **114**: 570, 1941.
29. Whipple, A. O.: The Rationale of Radical Surgery for Cancer of the Pancreas and Ampullary Regions, Ann. Surg. **114**: 612, 1941.
30. Harvey, S. C., and Oughterson, A. W.: The Surgery of Carcinoma of the Pancreas and Ampullary Region, Ann. Surg. **115**: 1066, 1942.
31. Whipple, A. O.: Discussion of paper of Harvey and Oughterson.[30]
32. Waters, E. T., and Best, C. H.: The Pancreas as an Organ of Internal Secretion, J. A. M. A. **117**: 852, 1941.
33. Brunschwig, A.: One Stage Pancreatoduodenectomy, Surg., Gynec. & Obst. **77**: 581, 1943.
34. Cattell, R. B.: Successful Resection of Carcinoma of the Bile Duct, S. Clin. North America **23**: 747, 1943.

GYNECOMASTIA

With Report of Seven Cases

Major Elmer F. Gooel, Medical Corps, Army of the United States

(From the Surgical Service, Station Hospital, Camp San Luis Obispo, Calif.)

BENIGN breast enlargement in the young adult male is now being observed in increased concentrations, because of the congregation of men in the military service. Seven cases, classed as gynecomastia, are reported and discussed here in the interest of clarifying opinion on this controversial subject, and in order to emphasize certain points in the care and disposition of these cases.

Male breast enlargement including outspoken breast neoplasm is seen infrequently enough, in civilian practice comprising a heterogeneous assortment of men and women of all ages, to be underestimated and minimized. In addition, there is disagreement about etiology and treatment of those cases which are classed as gynecomastia. However, in the Military Service an opportunity is afforded to observe a concentration of such cases in a restricted age group. This is a situation unmatched by civilian experience, and one which requires a particular and expeditious solution. It does not appear unreasonable to suggest that the same principles may be found applicable in civilian practice as in military practice.

Unlike in civilian life, these men cannot be observed for long periods of time, nor can experimental treatment be instituted. The principle of treatment in the military service is to restore the soldier to physical fitness and to return him to full duty as soon as possible. The immediate deduction is that surgical excision is the only means of satisfying this principle.

The symptomatology is the same in all walks of life, except that in the Army the symptoms are more easily induced because of the wearing of the army pack, and irritation results through pressure of the pack strap. The consideration of having a soldier free of complaints is an important one. The cosmetic viewpoint and the point of ridicule and sensitiveness have been mentioned often and are not to be underemphasized where groups of men live together with little privacy. Sullivan and Munslow[1] arrived at similar conclusions in reporting five cases of gynecomastia, and offered surgical excision as their treatment of choice.

Received for publication, Feb. 28, 1944.

ETIOLOGY

Endocrine.—In a general consideration of the problem of gynecomastia, endocrine relationship has received the most attention. Wernicke[2] and Lewis and Geschickter[3] feel that because 15 per cent of such cases begin at or shortly after puberty there is a definite endocrine relationship. They, together with Adair[4] and Ivanissevich, Rivas, and Diez Canseco,[5] recommend treatment with testosterone. Wernicke reports three cases treated with testosterone, two with favorable results. There was recurrence in one case when treatment was stopped temporarily. He suggested that continued therapy with male hormone would be necessary to "maintain cure." Adair quotes Hoffman, who states that 50 per cent regression occurred in his cases in four weeks under testosterone therapy. Such continued and incomplete treatment obviously is impractical in the Military Service; and it is doubted that it would be desirable in most cases in any walk of life. Until another treatment can be found which will expedite a permanent and inexpensive cure, surgical excision appears to be the only choice.

Outspoken endocrine disturbances resulting from chorion-epithelioma and teratoma of the testicle or from tumors of the adrenal cortex are not the subject of controversy, for the cause and treatment are obvious. Difference of opinion arises over those cases in which there is a claim of androgen-estrogen imbalance of nonneoplastic origin.

Only one patient (Case 3) in the present series presented any semblance of endocrine dyscrasia. It must be admitted that no androgen or estrogen determinations were available; but it is to be noted that, except in one case (Case 4), the condition was unilateral. Six of the seven cases, including the case of bilateral breast involvement, yielded no history of endocrine disturbance on close questioning and presented no obvious signs on careful physical examination. The one patient in whom there was endocrine disorder (Case 3) had mumps and bilateral orchitis four years before. He presented small though not atrophied testicles and no stigmas of feminization. He reported no change in libido or change in secondary sexual characteristics since the orchitis. Furthermore, his breast lesion was of only one month's duration.

It is to be noted from Table I of the present series that in only two of the seven cases was swelling noticed at, or shortly after, puberty. The average age of the others was 28.4 years and the average duration of symptoms was 3.6 months, varying from one to six months.

Trauma.—No previous author has been impressed with the relationship of trauma to this disease. In fact, Horsley[6] felt that it was of little significance in considering the etiology of all types of lesions of the breast. Three of the patients in this series mentioned the possibility of trauma when questioned closely, but only one was definite (Case 4). There was trauma to only one breast in this case, yet he had bilateral breast involvement; this causes us to doubt the etiologic importance of trauma.

TABLE I

SUMMARY OF SEVEN CASES OF GYNECOMASTIA

CASE	AGE, RACE	DURATION	SIDE	TRAUMA	ENDOCRINE	DISCHARGE FROM NIPPLE	SYMPTOMS	PATHOLOGY REPORT
1	27 N	6 mo.	R	?	None	At time of operation	Fleeting pain thought result of bruise 6 mo. before; swelling 2 mo., tenderness	Mazoplasia of breast
2	34 W	1 mo.	R	No	None	No	Increasing swelling; tenderness from pack strap	Gynecomastia and squamous-cell metaplastia of intraductal papilloma
3	28 W	1 mo.	L	No	Mumps and orchitis 4 yr. before; small testicles	No	Gradual increase in size; soreness and tenderness on pressure	Gynecomastia; hyperplasia of ductal epithelium
4	21 W	6 to 7 yr.	RL	Yes	None	No	Pain and tenderness, left	Gynecomastia and slight chronic inflammation
5	24 W	6 mo.	L	?	None	No	Constant soreness	Gynecomastia
6	29 W	13 yr.	R	No	None	No	Gradual enlargement; discomfort on exercise	Gynecomastia
7	24 W	4 mo.	R	No	None	No	Pain and soreness on exercise and from pack strap	Gynecomastia

PATHOLOGY

Gynecomastia, most authors agree, presents a characteristic picture. The disease usually is unilateral. The breast is symmetrically rounded, resembling a pubertal female breast; it is soft or moderately firm and is freely movable under the skin without adherence to the nipple. Horsley[6] states that gynecomastia is true hypertrophy of the male breast, homologous with virginal hypertrophy in the female. There is little spontaneous pain except after violent exercise; but there is usually tenderness to pressure.

Histologically, the usual picture is that of an increase in length and moderate proliferation of the ducts, and an increase in amount of the periductal tissue. There is no acinar or lobule formation. The ducts are lined usually by two or three layers of cells varying from cuboidal to tall columnar epithelium, although there may be but a single layer. The periductal stroma is loose and the ducts are scattered through it. The ducts are dilated and usually are empty. It must not be forgotten, as Horsley[6] points out, that "the male breast is a complicated system of open ducts and gland tissue far from vestigial in nature," and that breast tissue in the adult male normally persists in essentially the same state as that in the preadolescent female. This indicates a potentiality for disease which, although small, must not be underestimated.

In one case (Case 1) there was discharge from the nipple, discovered only at the time of operation; this was greenish purulent material representing a process which could possibly have been the source of symptoms at a later date. The breast of another soldier (Case 2) presented a histologic picture of metaplasia in an intraductal papilloma in addition to the usual picture of gynecomastia; this often represents irritation, and is not entirely without significance as a possible premalignant state. It is certainly safer to have such breasts removed, considering the several indications, than to chance haphazard and prolonged observation. The risk of operation is slight, and the period of invalidism is very short. And, as one pathologist points out, how would we know what pathologic change is occurring in the breast until it is examined histologically?

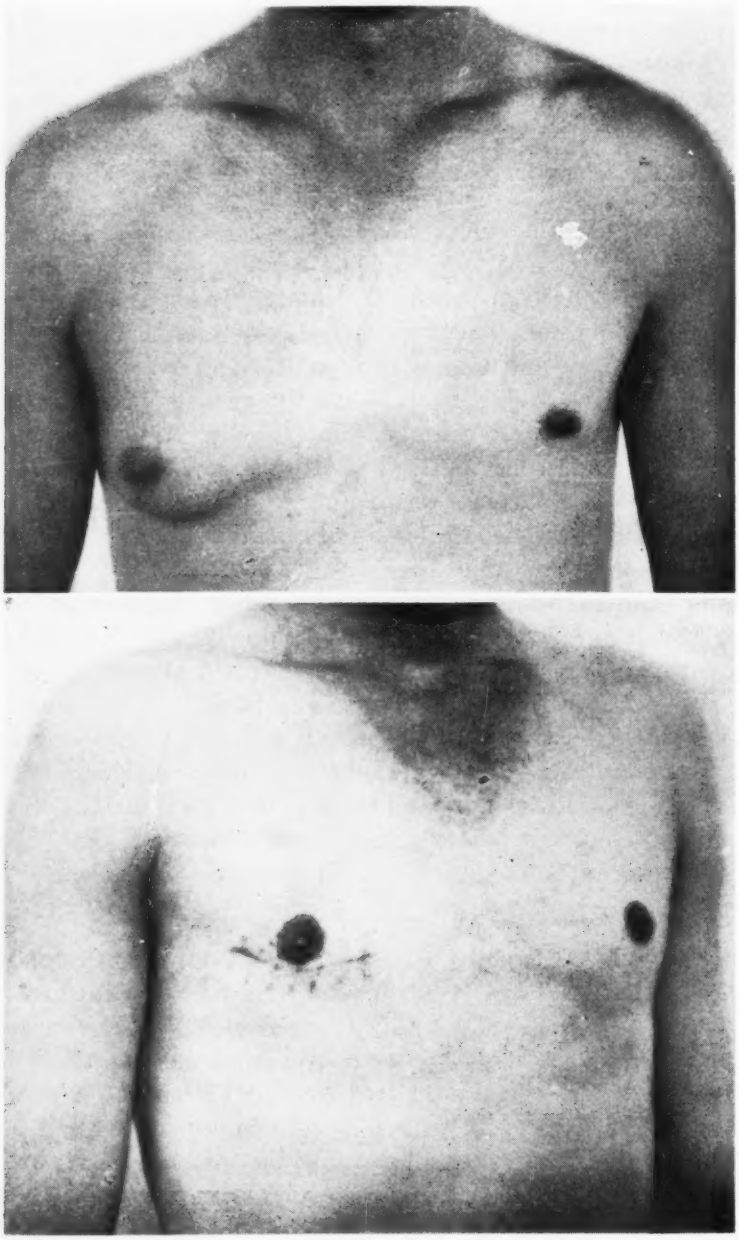
TREATMENT

All the patients in this series were treated by mastectomy. All were healed and ready for full duty in from ten days to three weeks, and all were asymptomatic when discharged to duty. The surgical approach was through a slightly curved, transverse incision made just inferior to the areola. This permitted easy dissection of the areola and nipple from the breast without injury, offered approach to all portions of the breast including the axillary prolongation, and permitted a cosmetically desirable closure without distortion of the areola.

The entire breast was excised. This apparently is important, since only a portion of the left breast in Case 4 had been removed at the first operation, following which symptoms continued. Local anesthesia was employed in the smaller breasts and intravenous sodium pentothal

(Case 6) where the breast was large, measuring about five inches in diameter. The dead space resulting from excision was obliterated by an elastic pressure bandage applied over the sterile dressings. There is no reason to make a radial incision such as is made when incising the female breast and when interference with ducts is to be avoided.

A.



B.

Fig. 1 (Case 7).—*A*, Preoperative photograph. *B*, Three weeks after operation, illustrating type of incision.

On the basis that an element of chronic mastitis is represented in some of these cases, agreement is found with Sullivan and Munslow[1] that treatment by hot packs and scientific neglect as advocated by Adair[4] (who states that "a period of several months finds the troublesome breast back to normal") is impractical and undesirable. The reader is referred to Case 4 of this series.

CASE REPORT

CASE 4.—The patient was a white soldier, 21 years of age, complaining of sharp, stabbing pain in the left breast much of the time. The pain was aggravated by exercise, and there was soreness on pressure. Six or seven years before, while working in the C.C.C., his left breast was struck with the handle of a farming tool, resulting in swelling which was treated conservatively. Some time later swelling of the right breast also was noted. He stated that swelling of both breasts was observed on induction into the army in 1941. Later in 1941, a bilateral breast operation was done through radial incisions in the upper outer quadrants. Report of histologic examination of tissue removed at this operation indicated bilateral gynecomastia with mild chronic mastitis.

The symptoms persisted on the left side to such an extent that the soldier was suspected of psychotic fixation on this area. He was referred to the hospital where examination revealed a broad, flat tumor lying behind and inferior to the areola of the left breast. The entire area was tender, and there was hypersensitiveness of the skin. All the breast tissue was excised through a transverse infra-areolar incision under local anesthesia. Healing occurred by first intention. The histologic findings were similar to those of the first operation. The genuineness of this soldier's complaints was proved by relief from symptoms within two weeks after operation. He stated upon discharge from the hospital that this was the first relief he had experienced in over two years in spite of a rather recent surgical wound.

CONCLUSIONS

1. Gynecomastia is a disease of unknown origin, and may be confused clinically with chronic mastitis.

2. The breast enlargement noted in this series produces undeniable symptoms which require prompt relief both for the good of the soldier and for the good of the service.

3. It is difficult to predict preoperatively exactly what pathologic change has occurred. Gynecomastia may be underlying, but mastitis or neoplasm may be contributory. Metaplasia in an intraductal papilloma was found in one case in this series.

4. Prompt relief of symptoms and permanent cure are obtained through complete mastectomy, thereby restoring the soldier to full duty with a minimum loss of time.

5. The type of incision employed has produced excellent results and is considered satisfactory (Fig. 1).

REFERENCES

1. Sullivan, J. M., and Munslow, R. A.: J. A. M. A. **118**: 1443, 1942.
2. Wernicke, H. O.: SURGERY **5**: 217, 1939.
3. Lewis, D., and Geschickter, C. F.: Ann. Surg. **100**: 779, 1934.
4. Adair, F.: West. J. Surg. **48**: 645, 1940.
5. Ivanissevich, O., Rivas, C. I., and Diez Canseco, J. B.: Semana méd. **48**: 14, 1941.
6. Horsley, J. S.: Ann. Surg. **109**: 912, 1939.

CARCINOMA OF THE BREAST

A Comparative Clinical and Pathologic Study of Tumors Metastasizing to Bone and to Viscera

Francis X. Paletta, M.D., and Edwin P. Lehman, M.D.
Charlottesville, Va.

(From the Department of Surgery and Gynecology, the McIntyre Tumor Clinic and the University Hospital, University of Virginia School of Medicine)

IT IS clinically well recognized that the distant metastases of breast cancer are of two main and often independent varieties, namely, skeletal and visceral. This distinction is seen repeatedly in advanced stages of cancer of the breast. Multiple and repeated bone metastasis may occur without the clinical appearance of visceral metastases, or patients may die of pulmonary, cerebral, or abdominal metastases with no clinical evidence of bone metastasis. This is distinctly a clinical phenomenon. Pathologists cannot recognize this differentiation since at autopsy metastases are found most frequently in both bone and viscera.[4, 8, 11, 12] This terminal finding does not contradict the fact that certain breast cancers have a primary affinity for skeletal and others for visceral metastasis.

Since metastasis in bone is more safely and successfully treated by x-ray than is metastasis in visceral organs, the prolongation of life by treatment might be expected to be more effective in the former case than in the latter. It would, therefore, be useful if one could predict from the clinical or pathologic character of any individual growth whether bone or visceral metastasis is the more likely. The present study is an attempt to analyze the characteristics of a group of breast cancers presenting distant metastasis of each variety.

A previous report on the breast material from this clinic, in 1934,[3] includes many of the cases reported here. This presentation will consist of two independent portions: first, a brief résumé of cases of carcinoma of the breast operated upon at the University of Virginia Hospital with an analysis of the five-year results, and second, a comparative analysis of cases of carcinoma of the breast metastasizing to bone and to viscera respectively.

PART I

CARCINOMA OF THE BREAST, UNIVERSITY OF VIRGINIA HOSPITAL, 1926 TO 1942

Material.—Two hundred and sixty-seven cases of carcinoma of the breast were studied at the University of Virginia Hospital during the

Received for publication, March 3, 1944.

years 1926 to 1942 (Table I). One hundred and seventy-seven patients (66 per cent) had radical mastectomy, 118 more than five years before. Of the 118 patients operated on in 1926 to 1937, 71 (60 per cent) had axillary metastases microscopically and 47 (40 per cent) did not.

TABLE I

RADICAL OPERATIONS			
Less than 5 years before		59	
Five years before—plus			
a. Without axillary metastases	47		
b. With axillary metastases	71		
Total		118	
		177	
Other therapy (radiation with or without simple mastectomy)			90
Total cases			267

Sixty-one of the 118 cases were treated by surgery alone and 57 were treated by surgery combined with irradiation. Two cases were considered inoperable when first seen but were later subjected to radical operation following a course of irradiation.

Results of Treatment.—There was a total of 49 per cent five-year survivals (Table II).* Cases without axillary metastases resulted in

TABLE II

FIVE-YEAR RESULTS IN GROUP TREATED BY RADICAL OPERATION

	NO. CASES	5-YR. SURVIVAL (%)
Group I—no axillary metastasis	47	65.9
Group II—with axillary metastasis	71	38.0
Total	118	49.0
Treatment		
Surgery alone		
No axillary metastasis	31	58.0
With axillary metastasis	30	46.6
Surgery plus postoperative irradiation		
No axillary metastasis	16	80.0
With axillary metastasis	36	30.6
Preoperative irradiation plus surgery		
With axillary metastasis	5	40.0

65.9 per cent five-year survivals. In this group, the five-year survival rate following surgery alone was 58 per cent, as compared to 80 per cent following surgery and irradiation. The small number of patients (16) who were subjected to irradiation is explained by the practice followed in recent years of relying on surgery alone in this group. Certainly this small number gives little significance to the high survival rate.

In the group with axillary metastases, the percentage of five-year survivals was 38 per cent. The results obtained by surgery alone in the group with axillary metastases were 46.6 per cent, as compared to

*The term five-year survival indicates no clinical evidence of disease at the end of five years following treatment.

30.6 per cent when treatment was by surgery and postoperative irradiation. There were five patients treated by preoperative irradiation followed by surgery; two of these were free of disease for five years.

Twelve per cent of the patients had recurrence in the field of operation.

Age as a Factor in Prognosis.—The largest group of carcinomas occurred in patients between the ages of 41 and 45 years (Fig. 1). A high percentage of five-year survivals was obtained between the ages of 36 and 45 years. There were 63.6 per cent in the first five years and 62.5 per cent in the second. The lowest percentage of five-year survivals occurred between 51 and 55 years of age, namely, 18.7 per cent. It is probable that these differences have no significance, since the number of cases in each group is small.

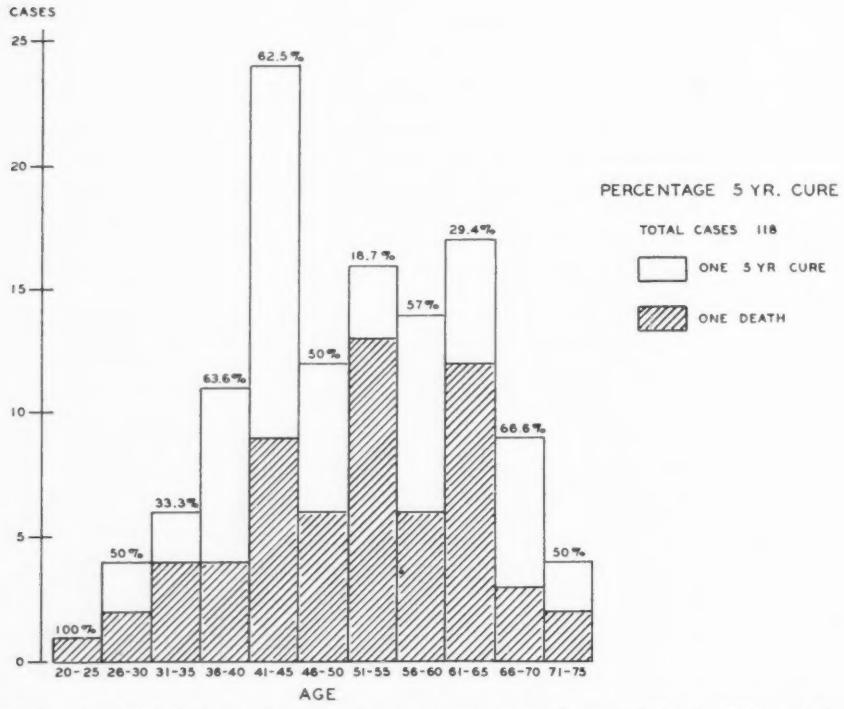


Fig. 1.—Age distribution of cases of carcinoma of the breast, 1926 to 1942, showing five-year survival rate for each age period.

Discussion.—As already stated, the practice in this clinic in recent years has been to give postoperative irradiation in operable breast carcinoma only to those patients who present pathologically proved axillary metastasis, representing 60 per cent of the present material. It is, therefore, interesting to observe that in the presence of nearly 50 per cent total five-year survivals, the five-year survival rate of cancer limited to the breast is only 65.9 per cent, whereas, the five-year survival rate of patients with axillary metastasis is 38 per cent. As compared

with results reported from other clinics the overall rate is satisfactory, the rate in the presence of axillary metastasis is good, and the rate in breast-limited disease is disappointing. A suggestion is naturally presented to the effect that postoperative irradiation has been beneficial. In two-thirds of the favorable cases (Table II) the patients received no irradiation with relatively poor results; whereas over one-half of the unfavorable cases received irradiation with relatively good results. It would not be justified, of course, from this small amount of material to affirm on these figures the efficacy of postoperative x-ray treatment.

The other figures presented in Part I of the present study are routine in nature and not subject to generalization. It may be noted that Simmons[9] found no relationship between age and end results, a conclusion which the present results tend to confirm (Fig. 1). The age of greatest incidence of the disease in this series is somewhat less than that reported elsewhere.[1]

PART II

COMPARATIVE STUDY OF CARCINOMA OF THE BREAST METASTASIZING TO BONE AND TO VISCERA

Material.—The material in this portion of the study includes 90 cases. Many of the patients first presented themselves when the carcinoma was in a late stage with metastases already developed, and others received primary treatment in this clinic. There were 35 patients presenting clinical evidence of visceral metastasis, 48 presenting clinical evidence of bone metastasis, and 7 presenting clinical evidence of both. The material was studied by comparing the clinical features, treatment, course, and pathology of the disease in the two larger groups. In addition, data are given for sequence of metastasis to bone and viscera in the 7 patients presenting evidence of both.

The usual distribution of bone metastases was found.[4, 10, 11] In 89.5 per cent of cases, the metastasis included the vertebrae and in 52 per cent of cases, the lumbar spine. The pelvis was involved in 40 per cent of the cases, femur in 38 per cent, ribs 30 per cent, and skull 19 per cent. Other bones involved were clavicle, scapula, humerus, and tibia. Thirty-eight patients showed metastases of the osteolytic type, 2 osteoblastic, and 8 both osteolytic and osteoblastic. It is interesting that 3 of those showing osteoblastic changes were late metastases, occurring respectively five, seven, and eleven years following treatment. One patient had generalized cystic changes of the bones and a diagnosis of osteitis fibrosa cystica was contemplated. The parathyroid glands were explored and found to be normal. We were unable to demonstrate previously existing bone disease in any of our cases.

The sites of visceral metastases diagnosed clinically were as follows: Forty-six per cent were in the lung, 31 per cent in the liver, and 23 per cent in the brain.

There were 7 patients having clinical evidence of metastasis to both bone and viscera. Three had pulmonary metastases, 3 had metastases to the liver, and 1 had both pulmonary and hepatic involvement. In 5 of the patients the symptoms were chiefly pain due to metastasis to the bones. Two patients complained of symptoms referable to the viscera. Of these 7 patients, 3 in all probability developed bone metastasis first. In the other 4 cases, the metastases in both viscera and bone were recognized at the same time.

Age.—The age distribution of the group that developed visceral metastases reached the peak at from 46 to 50 years (Fig. 2). At this period the incidence of cases with bone metastases was at its lowest. In the cases with bone metastasis there were two high peaks, one at 41 to 45 (premenopausal), the other 56 to 60 years (postmenopausal).

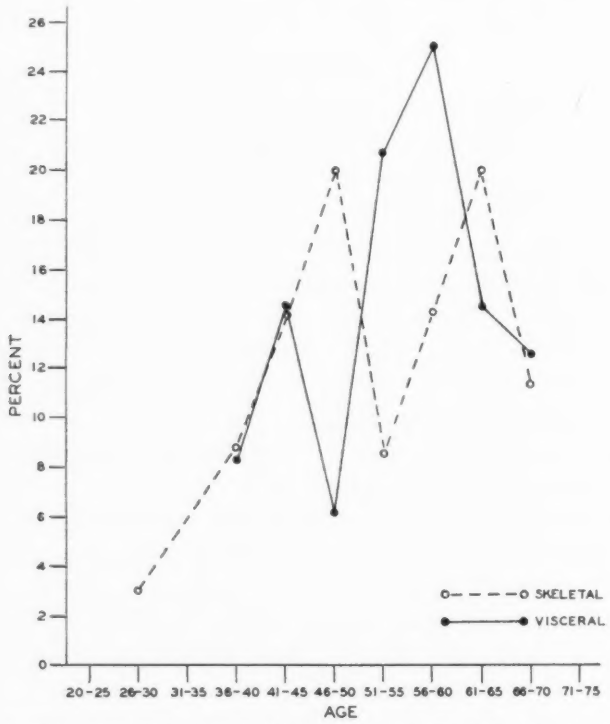


Fig. 2.—Age incidence at first observation of cases that at the time or later showed visceral or skeletal metastasis.

Menopause.—When first seen, 26.6 per cent of the patients in the group with bone metastases had not reached the menopause as compared to 34.4 per cent in the group with visceral metastases.

Duration of Symptoms.—One-third of the patients developing visceral metastases were first treated within three months after the occurrence of a mass in the breast as compared to one-fifth of the patients with bone metastases (Table III). Seventy-three per cent of the patients

TABLE III

DURATION OF MASS IN BREAST BEFORE TREATMENT

TIME	BONE METASTASIS (%)	VISCERAL METASTASIS (%)
Less than 3 mo.	20	33.0
Less than 6 mo.	40	45.0
Less than 9 mo.	52	57.0
Less than 12 mo.	64	73.0
Less than 2 yr.	72	88.0
Less than 3 yr.	76	91.0
Less than 4 yr.	92	100.0
Less than 10 yr.	100	

with visceral metastases were treated before the mass had been present one year, as compared to 64 per cent of those with bone metastases.

Position of Tumors.—The largest number of tumors occurred in the outer upper quadrant in both groups, 50 per cent of the bone and 47 per cent of the visceral (Table IV). There is no significant difference

TABLE IV

POSITION OF PRIMARY TUMORS

POSITION	BONE METASTASIS (%)	VISCERAL METASTASIS (%)
Outer upper quadrant	50	47
Inner upper quadrant	20	15
Central	10	6
Outer lower quadrant	14	23
Inner lower quadrant	6	9

between the percentage of tumors occurring in the different quadrants when the two groups are compared.

Size and Fixation of Tumors.—Seven per cent of the primary tumors in the group with bone metastases were less than 2 cm. in diameter as compared to 13 per cent in the group with visceral metastases (Table V). In general, the tumors were somewhat larger in patients with

TABLE V

SIZE AND FIXATION OF PRIMARY TUMORS

SIZE IN DIAMETERS	BONE METASTASIS (%)	VISCERAL METASTASIS (%)
Up to 2 cm.	7	13
3 to 4 cm.	43	39
5 to 6 cm.	36	23
7 to 8 cm.	7	10
More than 8 cm.	7	15
FIXATION		
Attached to skin	94	71
Attached to chest wall	22	13
Freely movable	11	29

visceral metastases, 25 per cent having diameters greater than 7 cm. as compared to 14 per cent in those with bone metastases. Ninety-

four per cent of tumors in patients with bone metastases showed skin attachment as compared with 71 per cent with visceral. Twenty-nine per cent of the latter were freely movable and only 11 per cent of the former.

Axillary Metastases.—In the group having bone metastases, 73 per cent had clinical evidence of axillary metastases as compared to 76 per cent in the group with visceral metastases. Since a number of patients in both groups did not have radical mastectomy and hence lack pathologic confirmation of the clinical findings, these data have little significance.

Primary Treatment.—In the group developing visceral metastases, 77 per cent were treated by radical mastectomy as compared to only 52.1 per cent in the group with bone metastases. Twenty-three per cent of the patients in the latter group had simple mastectomy, as compared to 11.4 per cent in the former. Irradiation alone or associated with surgical treatment was given to a higher percentage of patients with visceral metastases.

Biopsies.—One-third of the patients with bone metastases were subjected to biopsy, as compared to two-fifths with visceral metastases.

Time of Occurrence of Symptoms of Metastasis After Primary Treatment.—There were 25 patients with bone metastasis and 25 with visceral metastasis, in which the history was sufficiently detailed to give a fairly accurate estimation of the interval following primary treatment at which the first symptoms of metastasis occurred. At the end of three months, 20 per cent in the first group complained of bone pain, whereas none of the patients with visceral metastases had symptoms (Table VI). By the end of one year, 40 per cent of the patients with bone metastases had symptoms in comparison to 36 per cent of those with visceral. Seventy-six per cent of the visceral metastases occurred between six months and two years following treatment, and the bone metastases between three months and three years. Although symptoms occurred earlier in the latter group, the longest delays in metastasis were also in this group, namely, 7, 11, and 13 years.

TABLE VI

INTERVAL BETWEEN INITIAL TREATMENT AND FIRST APPEARANCE OF SYMPTOMS OF METASTASIS

(Percentages Are Cumulative)

INTERVAL	BONE (25 CASES) (%)	VISCERAL (25 CASES) (%)
Less than 3 mo.	20	0
Less than 6 mo.	20	8
Less than 1 yr.	40	36
Less than 2 yr.	60	76
Less than 3 yr.	76	80
Less than 4 yr.	80	88
Less than 5 yr.	88	92
After 5 yr.	100	100

Duration of Life After Diagnosis of Metastasis.—The duration of life was greater after the diagnosis of bone metastasis than after the diagnosis of visceral metastasis (Table VII). At the end of one year,

TABLE VII

DURATION OF LIFE AFTER DIAGNOSIS OF METASTASIS

DEAD AT END OF	BONE METASTASIS (%)	VISCERAL METASTASIS (%)
1 yr.	60	87
2 yr.	84	94
3 yr.	93	100
4 yr.	100	

60 per cent of the patients with bone metastases were dead in comparison with 87 per cent with visceral metastases; 7 per cent of the former lived over three years as compared with none of the latter.

Pathology.—Infiltrating duct carcinoma was the predominant pathologic type in both groups, 97 per cent of the bone and 96 per cent of the visceral (Table VIII). Histologic grading of the tumors demon-

TABLE VIII

PATHOLOGY OF PRIMARY TUMORS

	GROUP WITH BONE METASTASIS (%)	GROUP WITH VISCERAL METASTASIS %
Type		
Infiltrating duct carcinoma	97	96
Colloid carcinoma	3	4
Grade		
Grade 2	50	77
Grade 2+	28	23
Grade 3	22	0
Lymphatic invasion		
Minimal	72	73
Moderate	28	27
Dominant cell size		
Small cell	59	27
Medium cell	41	42
Large cell	0	31
Type of growth		
Simplex	85	79
Adenocarcinoma	3	12
Solid and alveolar	6	3
Colloid	6	3
Comedo	0	3
Scirrhous tendency		
No or minimal tendency	59	62
Moderate tendency	41	38
Marked tendency	0	0

strated that the average malignancy was higher in the group with bone metastases than with visceral metastases. Twenty-two per cent of the former were placed in grade 3 as compared with none of the lat-

ter. The degree of lymphatic invasion was about the same in the two groups. The characteristic cell of the tumor was small in 59 per cent of the cases in the group with bone metastases and in only 27 per cent of the cases in the group with visceral metastases. An interesting observation was the preponderance of the simplex type of growth in the group with bone metastases. Although the percentage of the simplex variety as the dominant type in the tumors of the two groups was not greatly different (85 and 79 per cent), the degree of preponderance of simplex structure within the substance of the individual tumors was far greater in the group with bone metastases. Many of the microscopic slides of tumors in patients with bone metastases showed carcinoma simplex only, whereas in many with visceral metastases, this type of architecture exhibited only a dominance over other types of growth. The scirrhous tendency was about the same in both groups. The predominance of the smaller cell and the simplex type of architecture in the group with bone metastases are indications, of course, of the somewhat more malignant characteristics expressed in the higher average grading of these tumors.

Discussion.—The data presented in these comparisons do not permit prediction in the individual case of breast cancer of the type of metastasis to be expected. However, certain differences may be seen which distinguish the two groups in some degree. The most striking of these differences seems to indicate that the tumors metastasizing to bone are more malignant than those metastasizing to viscera. This is evidenced by the higher pathologic grading with its accompanying predominance of the small cell and simplex structure, the higher incidence of fixation to the skin and chest wall, the lower rate of radical mastectomy as primary treatment, and the lower rate of biopsy. The shorter interval between primary treatment and the onset of symptoms of metastasis may have the same significance, but may equally as well be due to the earlier development of symptoms from bone metastasis than from visceral metastasis of equal volume. Furthermore, it may be related indirectly to greater malignancy since the tumors with bone metastases were in general more advanced when first treated. An additional indication of greater malignancy is the fact that the tumors in this group were of a smaller average size than those with visceral metastases and yet were clinically more advanced as judged by attachments and operability. An observation that does not support the evidence showing greater malignancy in the tumors with a predilection for bone is the longer average interval between the discovery of a mass and the seeking of medical aid.

The data dealing with age and with the menopause are also somewhat opposed to the general conclusion. Farrow and Woodward[2] found similar premenopausal and postmenopausal peaks of bone metastasis. Oleh[6] reported that more than one-half of women over 50 years of age who have breast cancer are either still menstruating or have suffered previously a delayed menopause. If ovarian activity is related to breast cancer, as these figures and other well-known data suggest, then one

would expect the more malignant tumors to occur in the period of sexual activity. In the present series, a smaller proportion of patients with bone metastases than of those with visceral metastases were menstruating at the time of onset of the disease.

The greater duration of life after the diagnosis of bone metastasis is unquestionably due in large part to the greater potentialities of palliative treatment.

The predominantly osteolytic character of the bone metastases observed in this series is a common finding.[8, 10] It is interesting that Mason and Warren[5] have also reported a case in which bone metastases led to a consideration of hyperparathyroidism as a superimposed diagnosis. In this series no diseases of the bones containing metastases were observed.

The reported evidence indicating greater malignancy of breast tumors metastasizing primarily to bone as compared to those metastasizing to viscera, is, to repeat, of no clinical value in prognosis. The clinical phenomenon, however, is so striking that essential fundamental differences in the two types might be predicted.

CONCLUSION

A comparison between breast carcinomas metastasizing primarily to bone and those metastasizing primarily to viscera suggests a slightly higher grade of malignancy in the former.

We are indebted to Dr. V. W. Archer, Professor of Roentgenology, for reviewing the x-rays, and to Dr. Ansell Derrick, formerly Associate Professor of Pathology, for reviewing the microscopic sections.

REFERENCES

1. Crile, G. W.: An Analysis of 1347 Cases of Malignant Tumors of the Breast With Special Reference to Management and End-Results, Journal-Lancet **51**: 99-102, 1931.
2. Farrow, J. W., and Woodward, H. Q.: The Influence of Androgenic and Estrogenic Substances on the Serum Calcium, J. A. M. A. **118**: 339-343, 1942.
3. Gentile, A., Murphey, D. R., Jr., and Lehman, E. P.: Carcinoma of the Breast, Am. J. Surg. **25**: 91-96, 1934.
4. Fried, J. R., and Goldberg, H.: Frequency, Clinical Course, and Treatment of Metastases From Cancer of the Breast, Am. J. Roentgenol. **50**: 499-515, 1943.
5. Mason, R. L., and Warren, S.: Metastatic Carcinoma Simulating Hyperparathyroidism, Am. J. Path. **7**: 415-422, 1931.
6. Olch, I. Y.: The Menopausal Age in Women With Cancer of the Breast, Am. J. Cancer **30**: 563-566, 1937.
7. Paget, S.: The Distribution of Secondary Growths in Cancer of the Breast, Lancet **1**: 571-573, 1889.
8. Sharpe, W. S., and McDonald, J. R.: Reaction of Bone to Metastasis From Carcinoma of the Breast and Prostate, Arch. Path. **33**: 312-325, 1942.
9. Simmons, C. C.: Cancer of the Breast, New England J. Med. **226**: 173-178, 1942.
10. Sutherland, C. G., Decker, F. H., and Cilley, E. I. L.: Metastatic Malignant Lesions in Bone, Am. J. Cancer **16**: 1457-1488, 1932.
11. Turner, J. W., and Jaffe, H. L.: Metastatic Neoplasms, a Clinical and Roentgenological Study of Involvement of Skeleton and Lungs, Am. J. Roentgenol. **43**: 479-492, 1940.
12. Warren, S., and Witham, E. M.: Studies on Tumor Metastasis: 2. The Distribution of Metastases in Cancer of the Breast, Surg., Gynec. & Obst. **57**: 81-85, 1933.

EXPERIMENTAL ESOPHAGECTOMY

ORVAR SWENSON, M.D.,* BOSTON, MASS., AND
LIEUTENANT THOMAS V. MAGRUDER, JR., MEDICAL CORPS, U. S. ARMY

(From the Laboratory for Surgical Research, Harvard Medical School)

DURING the past decade there has been a revival of attempts to deal surgically with carcinoma of the esophagus, and esophagogastrostomy is now an established procedure for carcinoma of the distal portion of the esophagus. Surgical removal of carcinoma elsewhere in the intrathoracic esophagus still presents problems. It is practically impossible to make a successful end-to-end anastomosis after resecting more than 7 cm. of the esophagus.[1] The shortening due to resection of a portion of the esophagus produces tension and results inevitably in breakdown at the line of anastomosis. This has fostered the popular surgical conception that anastomosis of the esophagus is almost impossible. However, if tension at the suture line is avoided, anastomosis of the esophagus is feasible as demonstrated by experimental and clinical esophagogastrostomies.

Several methods for dealing with lesions of the middle third of the esophagus have been devised but the Torek procedure, of esophagectomy and exteriorization of the thoracic esophagus, is most commonly used. This technique has definite limitations and disadvantages. If the lesion is above the aortic arch the proximal end of the esophagus is too short to exteriorize below the clavicle on the chest.[4] It is possible to have an esophagostomy in the neck but it is hard to maintain a rubber tube in place because of changes in position of the neck and impingement on the larynx. Rubber tubes are a helpful device for bridging the gap from the esophagostomy and the gastrostomy but require constant care and may produce repeated attacks of cellulitis about the gastrostomy and esophagostomy. The fashioning of a cutaneous tube is difficult, time consuming, and subject to frequent complications, the chief of which is poor healing between the cutaneous tube and the gastric mucosa. To overcome this the distal end of the esophagus is sometimes used for a gastrostomy as the healing between skin and esophageal mucosa has fewer failures.[5] In males there may be continued growth of hair in the cutaneous tube, which may cause obstruction. This obstacle may be overcome by the use of a tube graft from a relatively hairless area.[4]

Beck,[6] in 1905, devised a long-tube gastrostomy by dividing a portion of the greater curvature from the stomach and suturing this into

Received for publication, March 6, 1944.
*Arthur Tracy Cabot Fellow and Assistant in Surgery.

a tube utilizing the left gastroepiploic artery for a blood supply. He reported performing this operation on animals and later attempted anastomoses between a low esophagostomy and the special gastrostomy extrathoracically, regretting that lack of anesthetic equipment prevented intrathoracic anastomoses. Jianu,[7] in 1912, without knowledge of Beck's work, performed the same type of gastrostomy on the cadaver. In recognition of the two men, the gastrostomy is now generally designated as the Beck-Jianu and is used extensively in some clinics.[8] Kay[9] demonstrated the feasibility in animals of intrathoracic anastomosis between a Beck-Jianu gastric tube and the proximal third of the esophagus, as had been suggested by Beck, but reported no long-term follow-up on the animals.

Johnson and Magruder,[10] in 1941 to 1942, attempted intrathoracic anastomosis between a Beck-Jianu gastric tube and the proximal third of the esophagus and succeeded in having several animals survive ten to fifteen days. As all of these animals had antiperistaltic esophagogastric anastomoses, this might have been the cause of the persistent vomiting. This problem was investigated by preparing one series of animals with antiperistaltic anastomoses and another with isoperistaltic anastomoses.

METHODS

The operation was divided into two stages: during the first, a tube 1½ to 2 cm. in diameter was made from the greater curvature of the stomach; at the second, a portion of the esophagus was resected and the gastric tube was anastomosed with the proximal end of the esophagus. Details of the first stage operation are as follows: Dogs 15 to 25 kilograms were used and under nembutal anesthesia splenectomy was performed. In order to determine the effect of the pyloric musculature on the function of the gastric tube, the pylorus was excluded from the tube in one series of animals while in another group the distal end of the tube included the pylorus. The tubes, varying from 15 to 25 cm. in length, were left attached to the fundus of the stomach (Fig. 1). The stomach was closed with two rows of inverting continuous black silk sutures. The gastric tube was harder to deal with, and to prevent shortening and maintain a straight pliable tube, two rows of interrupted inverting black silk sutures were used. The free end of the tube was attached with a silk suture to the left dome of the diaphragm, lateral to the left lobe of the liver. The animals did well postoperatively and regular kennel feedings were given and tolerated after the first or second postoperative day.

The second stage was more difficult. At first nembutal anesthesia was used but poor results forced a shift to intratracheal ether. A left-sided approach was imperative as it was impossible to reach the gastric tube through the right diaphragm. At first the incision was placed in the fifth interspace and the fifth and sixth ribs cut posteriorly. In later opera-

tions a better exposure was secured by an incision in the seventh interspace and cutting the seventh, sixth, fifth, and fourth ribs posteriorly. It was only necessary to make a 3 to 4 cm. incision in the left diaphragm, through which a portion of the stomach and then the gastric tube was delivered.

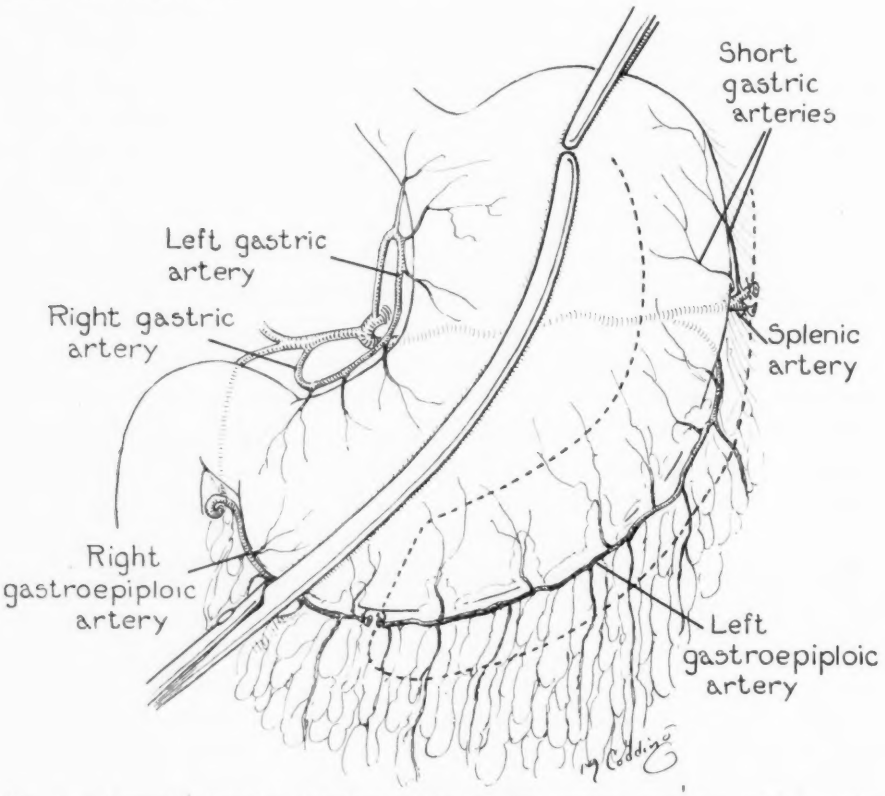


Fig. 1.—Schematic drawing showing portion of the greater curvature used for construction of gastric tube.

Two types of operations were done in the second stage. Isoperistaltic anastomoses were made in one group of animals by excising the gastric tube from the fundus of the stomach, and bringing the tube into the chest as a free graft with its blood supply through the left gastroepiploic artery (Fig. 2*B*). After resecting 12 to 15 cm. of the esophagus, the gap was filled with the free-tube graft, arranged so that the anastomoses were isoperistaltic. Designation of this as an isoperistaltic anastomosis is not absolutely correct because the presence of peristalsis is questionable. However, it was with the hope of learning more about this problem that the previously mentioned type of anastomosis was made, as well as the second type, which was antiperistaltic with the tube attached to the stomach and the pyloric end anastomosed to the proximal end of the resected esophagus (Fig. 2*A*). This arrangement made for a shorter second stage operation since only a single anastomosis was

necessary. In all cases the esophagus was resected to a point 2 to 3 cm. above the aortic arch and in some animals the resection was carried into the neck.

In dissection of the esophagus above the aortic arch, care must be taken to avoid injury to the thoracic duct. On two occasions it was cut inadvertently and the proximal end ligated. One animal had no untoward effects from this mishap. The second came to thoracotomy, draining a copious amount of serous exudate which gradually decreased and stopped completely in one month.

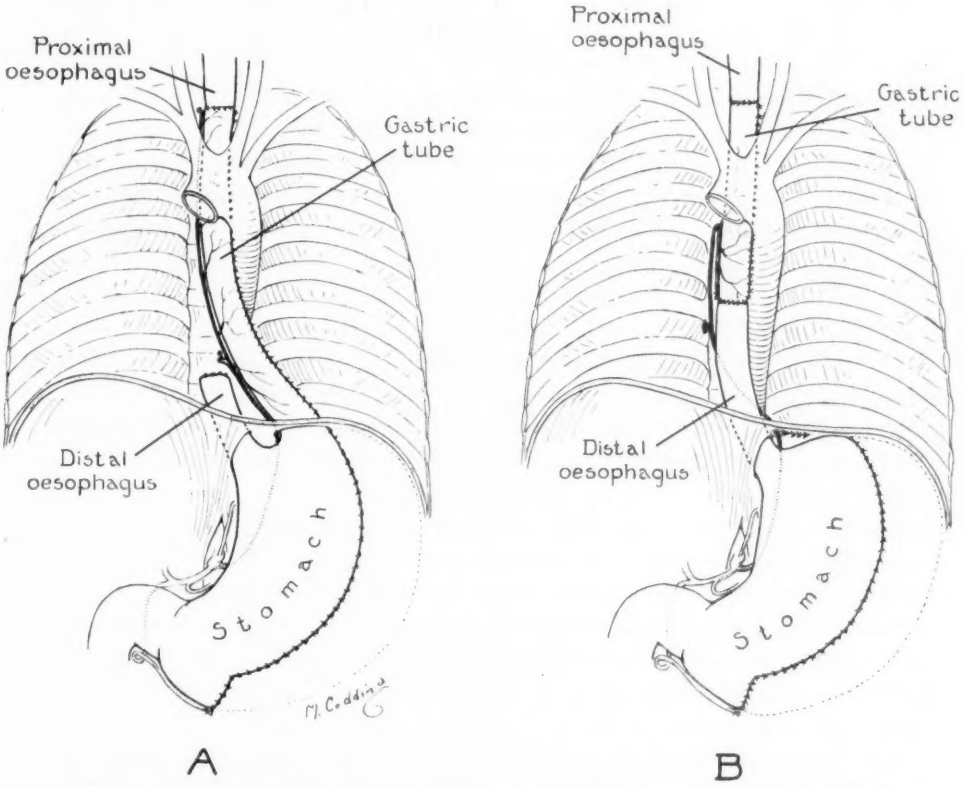


Fig. 2.—*A*, Schematic drawing showing an antiperistaltic anastomosis of the gastric tube to the proximal portion of the resected esophagus. Theoretically this is an antiperistaltic anastomosis in that the distal end of the gastric tube is placed in a proximal position in regard to the esophagus.

B, Schematic drawing showing how the gastric tube is used to fill the space left after resecting a portion of the esophagus. This is theoretically an isoperistaltic anastomosis in that the distal part of the graft was from the distal portion of the stomach.

In animals it is essential to be certain the lungs are well inflated before the chest is closed. Immediate postoperative aspiration of both sides of the chest is advisable, because in dogs the mediastinum is flimsy and frequently presents defects that make bilateral pneumothorax common after chest operations.

Postoperatively the animals were given a blood transfusion and parenteral fluids were administered for four days with 2 Gm. sodium

sulfathiazole daily. Only fluids were given by mouth for the first twenty-four hours. After that small feedings of ground horse meat and dehydrated dog food were given three times a day for one week. During the second week feedings were given two times a day and later the full daily ration was given in one feeding. As dogs tend to wolf their food it was essential to feed a wet mixture in which the maximum particle size was 1.5 cm.

RESULTS AND DISCUSSION

Thirty-nine animals were used in this set of experiments and after the first stage operation, four died of distemper. Two died of peritonitis caused by gross soiling of the peritoneal cavity at the time of operation. Inadvertently these dogs had been fed the day of operation and soiling was inevitable, when the distended stomach was opened, since no enterostomy clamps were used. By experience we found the incision along the greater curvature of the stomach was so long that regular enterostomy clamps were not of sufficient length and of little value in the operation. No leak had occurred along the anastomoses in these two animals; however, in two dogs there was ischemia of the gastric tube with perforation and peritonitis. Damage to the left gastroepiploic artery could have been avoided by ligating the splenic vessels at the hilum during splenectomy as was done in subsequent operations. The origin of the left gastroepiploic artery is inconstant in dogs and this precaution must be taken during splenectomy to insure integrity of the blood supply to the gastric tube.

Thirty-one animals survived the first operation and esophagectomy was done at a second stage. Nine of these animals were given nembutal anesthesia, and of this number, four were considered anesthetic deaths although pneumothorax and some degree of shock probably contributed as minor factors. However, with the use of intratracheal ether, and no chest aspirations in some instances, there were no anesthetic deaths in twenty-two operations.

Kay[9] had considerable difficulty in delivering the gastric tube into the chest during the second stage and suggested placing the tube in the chest during the first stage. We did not find this necessary because in only two instances was there any difficulty in bringing the Beck-Jianu tube into the chest during the thoracic operation, and in these animals there were small abscesses along the suture line in the gastric tube. These animals died within twenty-four hours of operation with acute empyema and peritonitis. Adhesions played a role in the postoperative death of another dog in that during the delivery of the gastric tube the left gastroepiploic vessels were adherent to the anterior abdominal wall at the site of the first operation and sufficient vascular damage was caused to have ischemia of the entire gastric tube. Adhesions should be ruled out by exploring through the diaphragmatic incision before the gastric tube is delivered.

One dog died of dehydration; he vomited persistently after operation and post-mortem demonstrated a mechanical block just below the esophagogastrostomy, produced by a twist in the gastric tube. This emphasizes the fact that it is vital in this operation to arrange the gastric tube with the greatest care so that there will be an unimpeded passageway from the esophagostomy into the stomach, as the swallowed food must traverse this space by its own momentum.

Six other animals died within the first week after operation, preventing observations over a long enough period for definite information on their ability to swallow. In one there was extensive bilateral pneumothorax and in another severe distemper. The third died when the pharyngeal pack was left in place as the intratracheal tube was removed. Postoperative pneumonia was the cause of death in one animal. Diaphragmatic hernia produced death in two dogs in this group.

The incidence of infection and leaks at the anastomosis was low and definitely related to the type of anastomosis made. Interrupted black silk sutures were used in all instances since it has been shown that continuous sutures lead to strictures more quickly than interrupted sutures.[2, 3] An inverting type of suture in one and two layers was used in making nine anastomoses and in three of these leaks occurred. In the next twenty-three anastomoses performed with two rows of interrupted noninverting silk sutures, no leaks or infection followed. The first row of interrupted sutures in the noninverting type of anastomosis passes through the mucosa and submucosa of the esophagus and gastric tube. The second row simply approximated the muscular layers of the two structures (Fig. 3). In the three failures, the explanation may be that some of the second row of sutures inadvertently perforated the esophageal mucosa and leaks occurred along the suture. If the second row of inverting sutures were not placed partially through the esophageal mucosa they had little holding power, for the muscular coats are flimsy. The mucosa is the strongest and toughest layer in the esophagus and should be used to the fullest extent in making esophageal anastomoses. Avoiding tension is the most important factor to observe in anastomosing the esophagus. At all times the gastric tube was ample in length, thus avoiding tension on the suture lines and making tension-holding sutures unnecessary.

Great care was used in making the anastomosis. The field was completely walled off with moist sponges. An enterostomy clamp was used across the gastric tube to prevent any gross soiling. Such a method was considered too harsh for the esophagus and if any fluid tended to gravitate from the mouth a small pack was placed in the hypopharynx. The sutures were placed at 3 mm. intervals and tied gently. This method was time consuming but paid well in results.

A second benefit was derived from this simple noninverting type of anastomosis because no diaphragm was formed. Postoperatively there is

considerable swelling and this, plus a diaphragm at the anastomosis, may produce a complete block during the first ten days while the swelling and diaphragm persist. It is most difficult to carry animals through the first ten postoperative days and therefore an anastomosis without a diaphragm enhances the chance for the animal to survive.

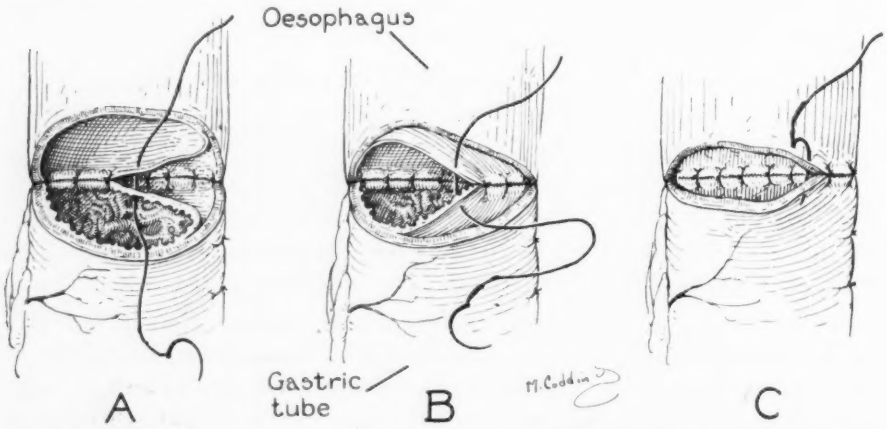


Fig. 3.—*A*, Showing the posterior row of interrupted sutures approximating the muscular layers of the esophagus and gastric tube in place. Some of the interrupted sutures approximating the mucosa of the esophagus and gastric tube are also in place.

B, Showing the posterior row of mucosal sutures completed. The anterior row of mucosal sutures are being placed.

C, Showing the completion of the anastomosis by placing interrupted sutures through the anterior musculature layers of the esophagus and gastric tube.

In no instance has an appreciable degree of stenosis developed in the animals postoperatively. The longest survival is now six months and the lumen at the anastomosis remains adequate; by fluoroscopy and esophagoscopy there has been no appreciable change. Stenosis does not seem to be a problem providing the anastomosis is made with interrupted sutures.

Sixteen animals, one-half with antiperistaltic and the rest with isoperistaltic anastomoses, survived at least fourteen days. This gave two series of animals to study from the standpoint of ability to swallow and the presence of peristalsis in the Beck-Jianu tube.

There has been considerable doubt about peristalsis in a tube made from the greater curvature of the stomach. Carter and his associates[11] studied four animals with such tubes and failed to demonstrate any peristalsis by fluoroscopy. Churchill[4] reports diminished or absent peristalsis in the fundus with spasm of the pylorus in human cases after esophagogastrostomies. Cutting of the vagi is believed by Scrimger[12] to produce pyloric spasm and absence of peristalsis in the stomach. In all of our second stage operations, great care was taken to prevent any injury to the vagi.

Frequently during first stage operations, when a portion of the pylorus was included in the tube, definite progressive peristaltic waves

were observed in the distal end of the tube. These were only seen on three occasions during the second stage operation. In six dogs studied fluoroscopically, four to six weeks after operation, the swallowed barium passed so quickly into the stomach that a slow peristaltic wave in the gastric tube could not be involved except in one animal who would take a large amount of barium, and at first the bolus passed quickly into the stomach. However, as a few mouthfuls were swallowed the gastric tube filled, then slowly emptied and this may have been due to progressive waves in the gastric tube, although gravity was probably the explanation.

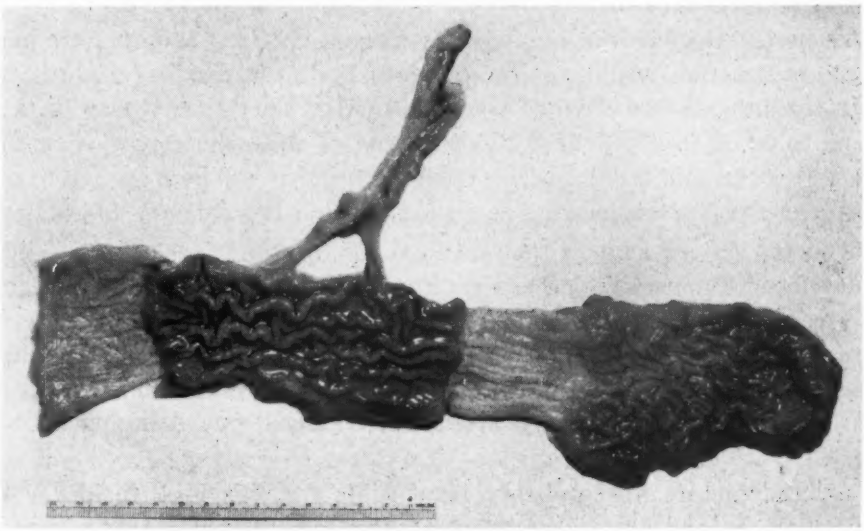


Fig. 4.—Specimen of gastric graft removed one month after operation. This shows the complete healing which takes place between the gastric tube and the proximal and distal portions of the esophagus.

In the series of eight animals with isoperistaltic anastomosis, no deaths resulted from vomiting. It must be kept in mind that in these animals the gastric tube did not need to be long and therefore included no pyloric musculature. Four of eight animals with antiperistaltic anastomosis died of dehydration and starvation due to vomiting. In each case of persistent vomiting the tube included considerable pyloric musculature. As these animals were observed under the fluoroscope, the barium would go to the region of the anastomosis and there meet an obstruction. The barium would actually bounce up the esophagus after it struck the block and as the animal repeatedly swallowed, the barium could be seen bouncing up and down until it reached a point high enough in the hypolarynx to produce vomiting. Although the appearance by fluoroscopy was that of mechanical obstruction, when these animals were esophagoscoped the anastomoses were well healed and there was no obstruction. As the animals died of dehydration, autopsy revealed the anastomosis well healed and slightly dilated with moderate dilatation of the esophagus above the anastomosis.

In the remaining animals with both anti- and isoperistaltic anastomoses, there was very little vomiting after the first three weeks, providing the food was wet and the maximum particle size was 1.5 cm. in diameter.

It would seem that the important point is to avoid including any of the heavy pyloric musculature in the gastric tube, and if this is done antiperistaltic anastomoses of the gastric tube to the esophagus can be made without serious impairment of the animal's ability to swallow. It is well known that the peristaltic waves in the stomach are quite slow, occurring at two- to three-minute intervals. Considering the speed of the peristaltic waves in the lower esophagus, the slow action of the gastric contraction would not fit well into the mechanism of deglutition. In the animals that vomited persistently after operation, it may be that the bolus of food produced a contraction of the pyloric portion of the gastric tube, and the duration of this contraction was long enough to act as a mechanical obstruction as the animal continued to try to swallow.

Of the sixteen animals that survived for fourteen days or more, eight developed diaphragmatic hernia. Four of these died of the hernia and three died during abdominal operations when attempts were made to repair the hernia. One dog survived an unsuccessful abdominal attempt to repair the hernia and recovered sufficiently to go through a successful transthoracic repair of the hernia; the animal was doing well four months after operation.

Three factors are probably responsible for this high incidence of hernia. In the first place, it is practically impossible to perform a tight closure of the diaphragm to the gastric tube because of the large fatty mesentery carrying the blood supply to the graft. Deep sutures placed in the fatty mesentery do not hold well and are dangerous in that they might damage or obstruct the blood supply to the gastric graft. Invariably some opening remains where this mesentery traverses the diaphragm. In the second place, in the early operations with an incision in the fifth interspace, the exposure of the diaphragm was so poor that careful suturing was impossible. To correct this the incision was placed in the seventh interspace and the seventh, sixth, fifth, and fourth ribs were cut posteriorly. Adequate exposures of the diaphragm as well as the esophagus above the aortic arch were secured by this approach. In the third place, the phrenic nerve was not crushed in most cases for fear of lowering further the animal's vital capacity postoperatively. Crushing was done in the last two animals and no hernia developed.

CONCLUSIONS

1. It is technically feasible to resect a portion of the esophagus behind and above the aortic arch in canines and to replace the lower two-thirds of the esophagus with a Beck-Jianu gastric tube.

2. Antiperistaltic esophagogastrostomies are perfectly feasible as long as the gastric tube does not contain pyloric musculature.

3. The best type of anastomosis for this special esophagogastrostomy is a noninverting anastomosis made with two rows of interrupted silk sutures.

4. Diaphragmatic hernia is the serious postoperative complication.

REFERENCES

1. Sauerbruch, F.: Die Chirurgie des Brustteils der Speiseröhre, Beitr. z. klin. Chir. **46**: 405, 1905.
2. Adams, W. E.: Resection of the Thoracic Esophagus, J. Thoracic Surg. **7**: 605, 1938.
3. Carter, B. N., Stevenson, J., and Abbott, O. A.: Experimental Esophagogastrostomy, J. Thoracic Surg. **10**: 446, 1940-41.
4. Churchill, E. D., and Sweet, R. H.: Transthoracic Resection of Tumors of the Stomach and Esophagus, Ann. Surg. **115**: 897, 1942.
5. Wookey, H.: The Surgical Treatment of Mid-esophageal Carcinoma, Brit. J. Surg. **27**: 696, 1939-40.
6. Beck, C., and Carrell, A.: Demonstration of Specimens Illustrating a Method of Formation of a Prethoracic Esophagus, Illinois M. J. **7**: 463, 1905.
7. Jianu, A.: Gastrostomie und Osophagoplastik, Deutsche Ztschr. f. Chir. **118**: 383, 1912.
8. Sweet, R. H.: Gastrostomy in Cases of Carcinoma of the Esophagus, Surg., Gynec. & Obst. **73**: 55, 1941.
9. Kay, E. B.: Experimental Observations on Reconstructive Intrathoracic Esophagogastric Anastomosis Following Resection of Esophagus for Carcinoma, Surg., Gynec. & Obst. **76**: 300, 1943.
10. Johnson, J., and Magruder, T. V.: Unpublished work.
11. Carter, B. N., Abbott, O. A., and Hanlon, C. R.: Experimental Study of Tubes Made From Greater Curvature of Stomach, J. Thoracic Surg. **11**: 494, 1942.
12. Scrimger, F. A. C.: Idiopathic Dilatation of Esophagus, Ann. Surg. **94**: 801, 1931.
13. Garlock, J. H.: The Surgical Treatment of Carcinoma of the Thoracic Esophagus, Surg., Gynec. & Obst. **70**: 556, 1940.

CONGENITAL MACROGINGIVAE (FIBROMATOSIS GINGIVAE) AND HYPERTRICHOSIS

LOUIS T. BYARS, M.D., F.A.C.S., AND BERNARD G. SARNAT, M.D.
ST. LOUIS, MO.
(From the Department of Surgery, Washington University, School of Medicine)

THIS report deals with the diagnosis and surgical treatment of persistent marked congenital hypertrophy of the gingival tissues and hypertrichosis in a 4-year-old girl. Because of the enlarged gingivae, few teeth are visible and a clinical diagnosis of anodontia or pseudoanodontia might be made. Because of the hypertrichosis, an endocrine dysfunction should be considered. There have been only a few such case reports, although the occurrence of congenital macrogingivae alone has been more common. The literature has been reviewed by Ruggles[1] and Mirolli.[2]

CASE REPORT

E. M., a white female aged 4 years, was originally seen, March 6, 1940, because of profuse growth of body hair since birth and failure of the teeth to come through the gums.

The patient was the fifth of six children. No unusual history was obtained of the prenatal period. The delivery was normal and the only unusual thing noted was the presence of curly black hair down the back of the neck. This hair became more prominent until, when the child was about 1 year of age, it was distributed over the entire back and extremities. The tips of the teeth did not appear in the oral cavity until the patient was 3 years old. There was no menstrual history. There was no family history of a similar disturbance. The siblings were light in complexion in contrast to the patient.

Physical examination revealed a fairly well-developed and nourished white female child with excessive black hair of the scalp, eyebrows, trunk, and extremities (Fig. 1). Pubic and axillary hair were not present; the breasts had not developed (Fig. 1*A*). The facial features were suggestive of prehistoric man. The lips protruded (Fig. 2*A*). Intraoral examination revealed enlarged firm gingivae which covered all but the incisal and occlusal surfaces of the crowns of the anterior teeth (Fig. 3*A*).

Radiographic studies of the skull, carpal bones, and jaws revealed a normal sella turcica and only two carpal ossification centers. Tooth development was normal. Deciduous teeth which had been exfoliated from the bone were trapped in the gum tissue. There was no evidence of missing teeth and the teeth were in normal relationship to the alveolar bone (Fig. 4).

Studies of the blood revealed the following: calcium, 12.2 mg. per cent; phosphorus, 4.0 mg. per cent; proteins, 7.14 mg. per cent; cholesterol, 170 mg. per cent; nonprotein nitrogen, 30.0 mg. per cent; chlorides, 585.0 mg. per cent; vitamin C, 0.270 mg. per cent. The blood cell and differential counts, the fasting blood

Received for publication, March 9, 1944.

sugar curve, and the basal metabolic rate were all within normal range. The Wassermann serologic reaction was negative.

A diagnosis of congenital macrogingivae and hypertrichosis was made. A tumor of the adrenal cortex, ovary, or pituitary glands was considered.

Follow-up was continued for over three years and there was no unusual change in the patient. Several deciduous teeth which should have been exfoliated were still retained in the gingivae and the permanent teeth which should have been prominent in the oral cavity showed only the tips of the crowns. The patient was

A. *B.*

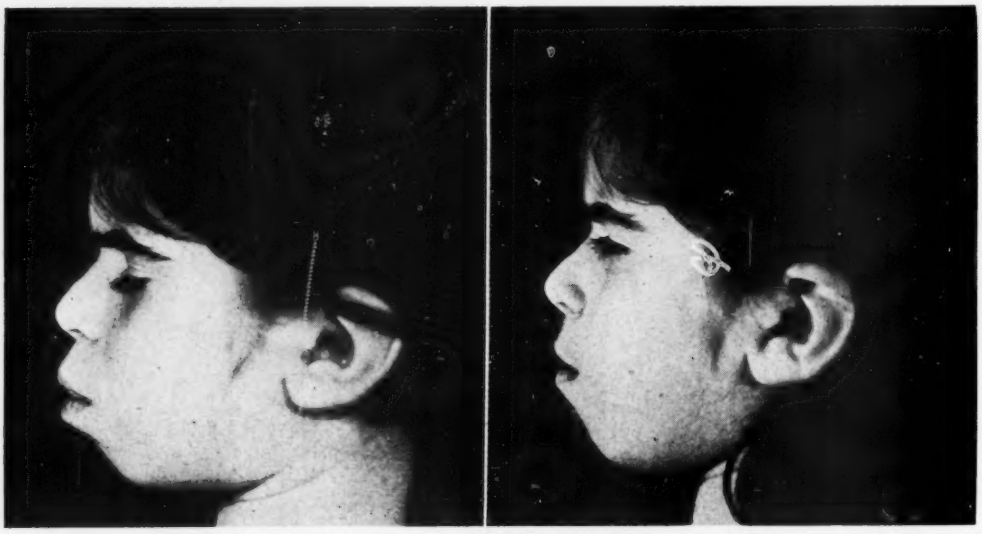
Fig. 1.—Photographs of patient with congenital macrogingivae and hypertrichosis at age of 7 years. (*A*) Note the distribution of hair over the extremities. There is neither pubic nor axillary hair. There is no development of the breasts. (*B*) Note the distribution of hair over the trunk and extremities. The physique is comparable to that of a youth.

readmitted to Children's Hospital of St. Louis, June 6, 1943, and the various examinations were repeated with no significant findings. The ketosteroid level was within normal limits, indicating the absence of a tumor or hyperplasia of the adrenals or a masculinizing tumor of the ovary. Feminizing tumors of the ovary were ruled out on physical examination.*

July 6, 1943, under ether-nitrous oxide endotracheal anesthesia, all maxillary gingival tissue was resected down to the periosteum of the alveolar bone, exposing

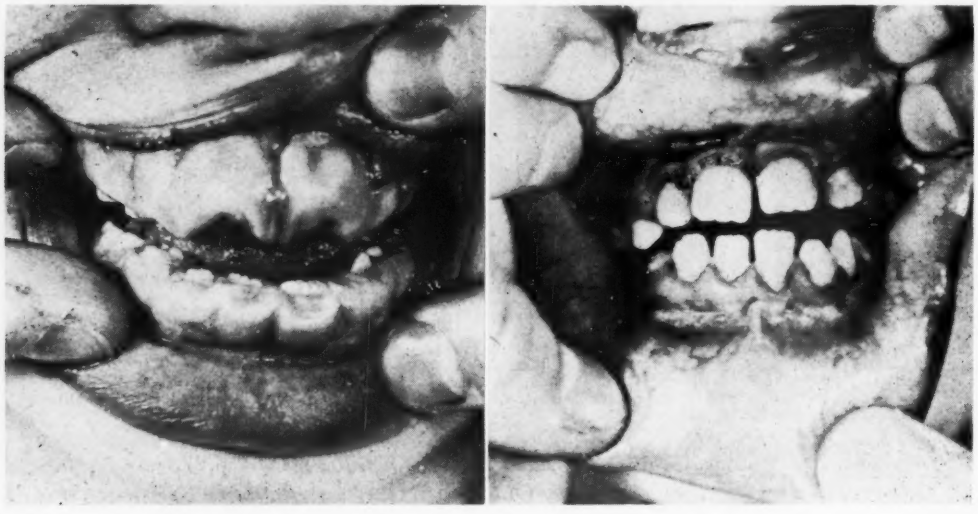
*Examination and report by Willard Allen: Endocrine Evaluation and Ketosteroid Determination and Interpretation.

the crowns of the teeth. The removal was done as thoroughly as possible with knife dissection. The mandibular gingival tissue was resected in a similar manner, Aug. 20, 1943. Bleeding was controlled readily. The raw areas were allowed to heal spontaneously.



A. *B.*

Fig. 2.—(*A*) Photograph taken preoperatively on June 15, 1943. Note the marked protrusion of the lips and heavy eyebrows. (*B*) Photograph taken on January 6, 1944, after complete resection of the maxillary and mandibular gingival tissue (see Fig. 3).



A. *B.*

Fig. 3.—Intraoral photographs of patient with congenital macrogingivae and hypertrichosis. (*A*) Photograph taken preoperatively on June 15, 1943. Note the massive size of the gingival tissues which caused the lips to protrude (see Fig. 2*A*). All but the incisal and occlusal surfaces of the teeth were covered. Normal mastication was not possible. (*B*) Photograph taken more than four months postoperatively. Up until March, 1944, the gingivae have had a normal clinical appearance.

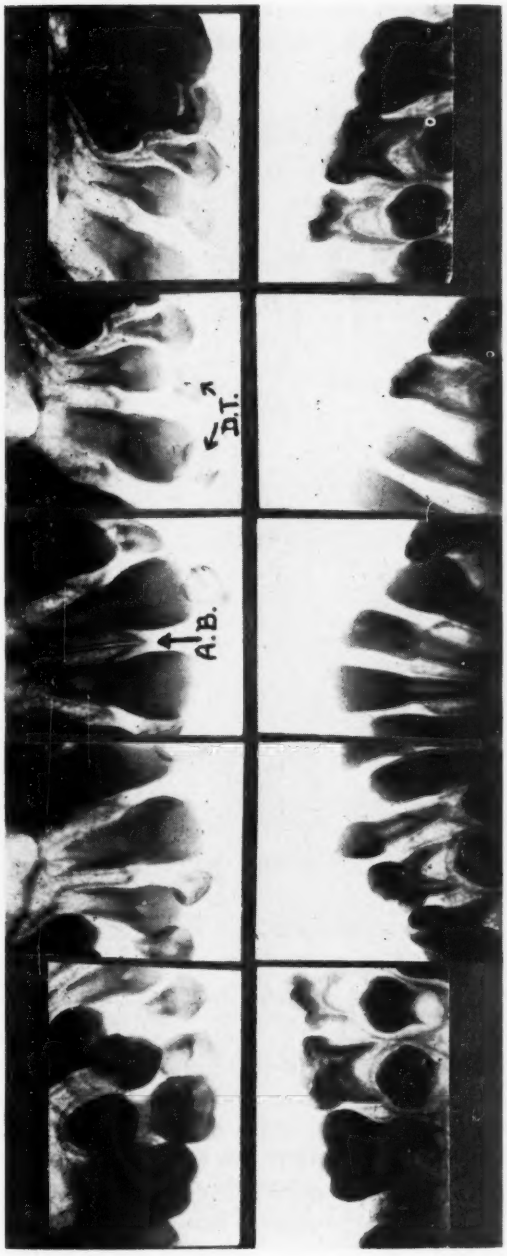


Fig. 4.—Intraoral radiographs taken Nov. 6, 1942. For this patient's chronologic age of 6 years, tooth development is within normal limits. The teeth have erupted and are in normal relationship to the alveolar bone (*A.B.*) Because the gingivae were so thick the partially resorbed deciduous teeth (*D.T.*) were retained. Anodontia and congenital macrogingivae can best be differentiated radiographically.

The histopathologic findings of the gingival tissue revealed that the epithelium was hyperplastic, and there was a relatively thick layer of keratin on the surface. There were numerous epithelial pegs extending deep into the connective tissue. In the subepithelial layer there were many bundles of large mature collagenous fibers. The lymphatics were dilated and there were a few isolated areas of round-cell infiltration. There was no other evidence of inflammation (Fig. 5).

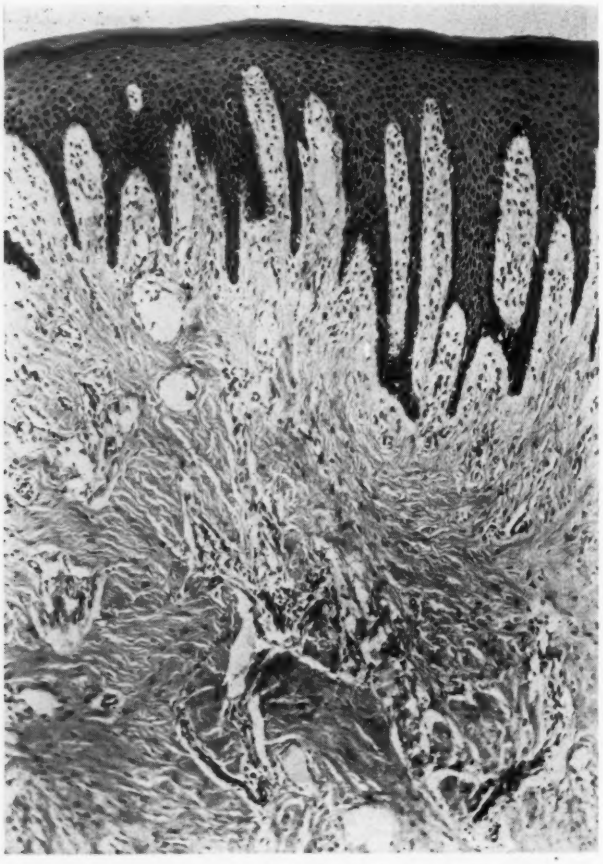


Fig. 5.—Photomicrograph of gingival tissue excised from a patient with congenital macrogingivae. Note the layer of keratin, hyperplastic epithelium, the deep epithelial pegs, and unusual amount of thick subepithelial connective tissue (see Fig. 6).

Histologic examination of skin obtained from the lateral thoracic wall revealed an increased pigmentation and hair follicles which were increased in size and number and extended through the dermis into the subcutaneous tissue. The epidermis was normal in appearance except for a small amount of round-cell infiltration immediately underlying the epithelium and edema in the subepithelial tissue.

The postoperative course was normal. Removal of the abnormal gingival tissues accomplished several things. (1) An immediate cosmetic result was obtained with the normal exposure of the teeth. (2) The maxillary and mandibular teeth were now able to occlude and the normal process of mastication could be performed. (3) The lips dropped back into a more normal position. At the time of this communication the patient had been observed for more than five months

postoperatively and there had been no return of the abnormal gingival tissue (Fig. 3*A*).

COMMENT

There is no good descriptive term which includes the etiologic, pathologic, and anatomic characteristics of this lesion. The etiology is most likely on a genetic basis. The term congenital macrogingivae, although not entirely satisfactory because it does not include the histopathologic description, is probably the best. Elephantiasis gingivae makes no distinction between congenital and acquired conditions. Keloid of the gum

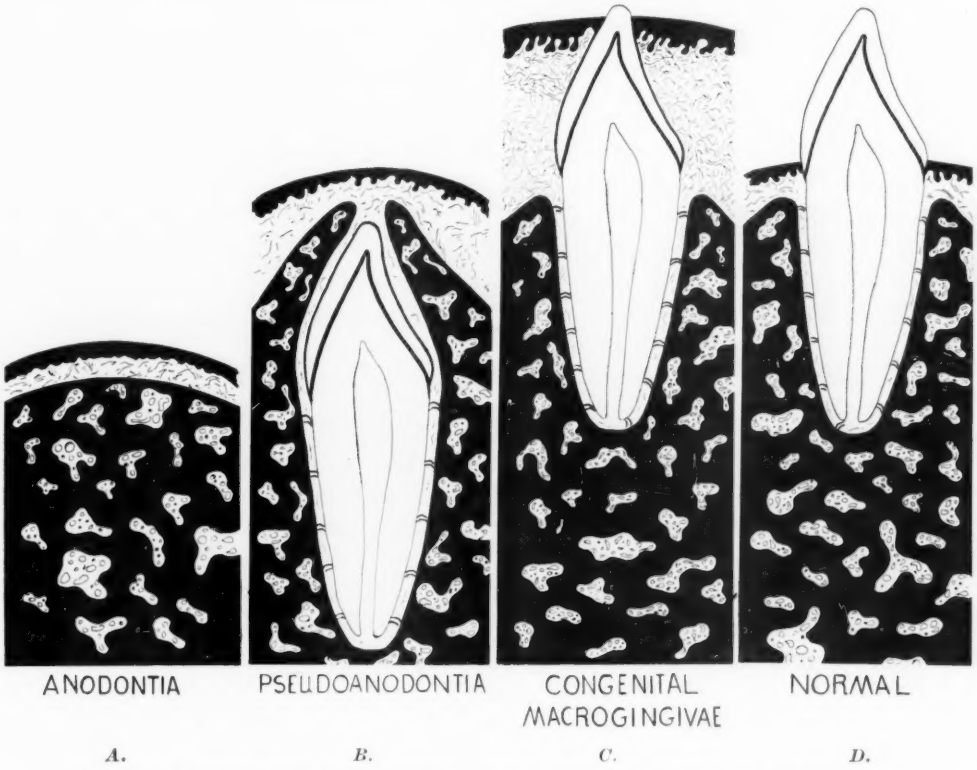


Fig. 6.—Diagrammatic representation of the dental structures in anodontia (*A*), pseudoanodontia (*B*), congenital macrogingivae (*C*), and the normal (*D*). *A*, Note the absence of the tooth and its supporting structures. *B*, The tooth and its supporting structures are present but the tooth, because it lacked adequate eruptive force, failed to appear in the oral cavity. *C*, The tooth has erupted into the oral cavity but is not apparent because of the markedly thickened subepithelial connective tissue.

does not consider local or general distribution of the tumor. Fibromatosis gingivae describes the condition on a pathologic basis. General enlargement of the gingivae is frequently seen in patients with blood dyscrasias, vitamin C deficiency, pyorrhea, hypertrophic gingivitis, who are pregnant, or taking dilantin sodium. These should be differentiated.

The occurrence of congenital macrogingivae alone is not common. For this to be associated with hypertrichosis is rare and there are only a few specific references[3] to this combination. This might be compared to cer-

tain ectodermal dysplasias which also vary in the number of structures affected.[4] One group may have teeth absent, a second group hair and teeth, and a third group, hair, teeth and nails affected.

Because of the diffuse fibrosis of the gingivae, sometimes, no teeth are seen in the oral cavity. This should be differentiated by means of radiographs from anodontia in which there is a lack of tooth development and pseudoanodontia in which the teeth have developed but lack the eruptive force to leave the dental crypts.[4, 5] In congenital macrogingivae the teeth are in normal relationship to the alveolar bone and are erupted but the excessive gingival tissue covers the crowns. These conditions are compared in Fig. 6.

CHOICE OF TREATMENT

Excision of all gingival tissue accomplished the desired purpose of dental function and esthetics. While the tissue may recur, it was believed to be the best treatment at this time. Radium was considered but not used because from the pathologic picture one would not expect benefit from radiation. In order to effect a permanent cure some have advised a more radical form of treatment requiring not only removal of the excess gingival tissue but also extraction of all teeth, growing and adult.

SUMMARY AND CONCLUSIONS

A case of congenital macrogingivae and hypertrichosis is reported in a patient, aged 4 years when originally seen. The gingivae were so large that the normally erupted teeth were completely covered. Treatment was by complete excision of the gingival tissue. The hypertrophy of the gingivae was due to extensive overgrowth of thick bundles of collagenous fibers in the subepithelial tissue. Thorough clinical and laboratory investigations of the endocrine glands revealed no correlation with either the macrogingivae or hypertrichosis.

REFERENCES

1. Ruggles: J. A. M. A. **84**: 20, 1925.
2. Mirolli, A.: Arch. ital. di chir. **29**: 401, 1931.
3. Thoma, K.: Oral Pathology, St. Louis, 1941, The C. V. Mosby Company, p. 140. Perreidt, cited by Mirolli.[2]
4. Brodie, A. G., and Sarnat, B. G.: Am. J. Dis. Child. **64**: 1046, 1942.
5. Ivy, R. H.: Dental Cosmos **75**: 689, 1933.

URINARY INFECTION AFTER COLOSTOMY

H. Milwidsky, M.D., and F. Mandl, M.D., Jerusalem, Palestine
(From the Surgical Department B, Hadassah-University Hospital)

COMPLICATIONS involving the urinary tract, particularly infection after abdominal operations, arising from the difficulty in emptying the bladder spontaneously, are by no means rare and require much attention in the management of the postoperative period.

There is also conformity of opinion that after certain operations on the lower abdomen (such as on the uterus or rectosigmoid), urinary disturbances are far more common than in connection with operations on the stomach, gall bladder, etc.

During recent years we always found it surprising how large a proportion of our patients on whom simple colostomy had been performed, no matter for what clinical reason, developed urinary complications.

We, therefore, set up a review of a series of 51 colostomies in regard to postoperative urinary complications, particularly infection. The patient's name, as well as age and clinical diagnosis, the site of the colostomy, and his urologic history were recorded. As far as this was possible, accurate analyses of the urine together with bacteriologic studies of the sediments and cultures were twice made prior to operation, and the same procedure was repeated between the fifth and fourteenth days after operation, with urine withdrawn under strict observance of sterility. Careful records were also kept concerning catheterization after operation. Table I allows a comparison of the pre- and postoperative data.

The cases under review included 25 men and 26 women, between 23 and 82 years of age.

Clinical diagnosis and indication for colostomy were: in 29 cases, carcinoma recti; in 4 cases, polyposis recti; in 13 cases, carcinoma of the colon; and in 5 cases, benign lesions of the rectum or colon.

Colostomy was in all these cases done according to the customary double-barrel method *(Maydl)*, the exteriorized loop riding on a drainage tube, namely: in 35 cases in the transverse colon, in 11 cases in the descendent colon, in 5 cases in the sigmoid.

Forty-eight patients were given spinal anesthesia with procaine hydrochloride, 120-160 mg.; 2 received general ether anesthesia and 1 local anesthesia.

The colostomy was opened, in accordance with the requirements of the individual case, between the second and ninth postoperative day, on an average of five days after operation.

Received for publication, March 7, 1944.

TABLE I

NAME	SEX	AGE	DIAGNOSIS	SITE OF COLOSTOMY	UROLOGIC ANAMNESIS	BEFORE OPERATION		DAYS	AFTER OPERATION		CATHETER	FEVER, DYSURIA ETC.
						URINALYSIS	CULTURE		URINALYSIS	CULTURE		
A. J.	M	35	Polyposis recti	Colon transv.	Ø	Normal	Sterile	6	Leucocytes epithelia	B. coli	No	No
A. M.	M	30	Ca. recti	Colon transv.	Ø	Normal	Sterile	7	Leucocytes epithelia	Staph. aureus	Yes, 1 day	Burning pain
W. M.	M	41	Megasigma (ileus)	Sigmoid	Ø	Normal	—	8	Leucocytes	B. proteus	No	No
M. T.	F	38	Ca. recti	Colon transv.	Ø	Normal	Sterile	5	Leucocytes	B. coli	No	No
S. J.	M	54	Ca. recti	Colon transv.	Ø	Normal	Sterile		Anuria	P. O.	Yes	Exitus
B. S.	M	33	Polyposis recti	Colon transv.	Ø	Normal	Sterile	10	Normal	Sterile	Yes, 3 days	No
L. R.	F	26	Ca. recti	Colon transv.	Ø	Normal	Sterile	6	Leucocytes	B. coli	Yes, 3 days	Yes
F. H.	F	64	Ca. recti		Ø	Alb.	Sterile	10	Leucocytes epithelia	B. coli	Yes, 2 days	Yes
D. M.	F	59	Ca. sigmoid	Sigmoid	Ø	Normal	Sterile	10	Leucocytes epithelia	Sterile	Yes, 2 days	No
C. J.	F	32	Ca. recti	Colon desc.	Ø	Alb.	Sterile	9	Leucocytes epithelia	B. coli	No	Yes
T. J.	M	82	Ca. sigmoid	Colon transv.	Prostatic hypertrophy	Alb.	Sterile	10	Alb. leucocytes	B. coli	Yes, indwelling, 10 days	Yes
K. J.	M	39	Ca. recti	Colon transv.	Ø	Normal	Sterile	14	Leucocytes	B. pyocyaneus	No	No
H. M.	M	62	Ca. sigmoid (ileus)	Colon transv.	Ø	Alb.	—	6	Leucocytes, casts	B. coli	Yes, 4 days	No
H. E.	M	64	Ca. recti	Colon transv.	Prostatic hypertrophy	Alb. leucocytes	Staph. aureus	14	Alb. leucocytes	B. coli	Yes, indwelling, 12 days	Dysuria
F. E.	F	45	Ca. recti	Colon transv.	Ø	Normal	—	12	Leucocytes	B. coli	No	No
A. H.	M	37	Ca. colon, desc.	Colon transv.	Ø	Normal	Sterile	11	Alb. leucocytes epithelia	B. coli	Yes, 4 days	Yes
W. A.	M	65	Ca. recti	Colon desc.	Ø	Normal	Sterile	14	Leucocytes	Sterile	Yes, indwelling, 10 days	Septicemia exitus
J. J.	M	61	Ca. sigmoid	Colon transv.	Ø	Normal	Sterile	5	Leucocytes	B. coli	Yes, 2 days	Yes
L. S.	M	30	Ca. recti	Colon transv.	Ø	Normal	Sterile	5	Leucocytes	B. coli	Yes, 2 days	Yes
S. A.	M	44	Colitis ulcerosa	Colon desc.	Ø	Normal	Sterile	10	Leucocytes	B. coli	No	No
E. P.	M	30	Ca. recti	Colon transv.	Ø	Normal	Sterile	7	Leucocytes	B. pyocyaneus	Yes, 1 day	No
E. E.	F	70	Ca. colon, transv.	Colon transv.	Ø	Normal	—	8	Normal	B. coli	No	No
W. R.	F	23	Ulcus callous, recti	Colon transv.	Ø	Normal	—	14	Normal	Sterile	Yes, 2 days	No

			recti									
L. B.	F	68	Ca. colon, transv.	Colon transv.	Ø	Normal	Sterile	6	Leucocytes, casts	B. coli	Yes, 2 days	No
L. B.	M	68	Ca. recti	Colon transv.	Ø	Alb.	—	10	Leucocytes	B. coli	Yes, 5 days	No
G. S.	F	53	Ca. recti	Colon transv.	Nephro-lithiasis	Alb.	—	10	Leucocytes	B. coli	Yes, 5 days	Burning pain
W. O.	M	58	Ca. recti	Colon transv.	Ø	Alb.	Sterile	5	Leucocytes	B. proteus	Yes, 3 days	Dysuria
R. N.	M	57	Ca. recti	Colon transv.	Ø	Normal	Sterile	7	Leucocytes	B. coli, B. proteus	Yes, 5 days	Yes
M. F.	F	50	Polyposis recti	Colon transv.	Ø	Normal	Sterile	8	Epithelia	B. coli	Yes, 3 days	Yes
R. L.	F	49	Ca. colon, desc.	Colon transv.	Ø	Normal	Sterile	11	Alb. leucocytes	B. coli	No	Dysuria
N. S.	M	45	Ca. recti	Colon desc.	Ø	Normal	Sterile	8	Leucocytes	B. pyocy-aneus	Yes, 5 days	Yes
A. M.	M	30	Ulcus perf. colon, trans.	Colon transv.	Ø	Normal	Sterile	7	Leucocytes	B. proteus	Yes, 2 days	Yes
H. A.	F	67	Ca. recti	Colon desc.	Ø	Normal	Sterile	10	Leucocytes	B. coli	No	No
G. B.	F	53	Ca. recti	Colon desc.	Ø	Normal	—	12	Epithelia	B. coli	Yes, 2 days	Yes
G. B.	F	64	Ca. recti	Colon transv.	Ø	Normal	Sterile	13	Epithelia	B. coli	Yes, 1 day	Yes
K. M.	F	44	Ca. recti	Colon transv.	Ø	Normal	Sterile	10	Leucocytes	B. coli	Yes, 1 day	Yes
R. S.	F	52	Ca. recti	Sigmoid	Nephritis	Normal	Sterile	9	Leucocytes	B. coli	No	No
H. L.	F	61	Ca. recti	Colon transv.	Ø	Normal	Sterile	8	Leucocytes	B. coli	No	No
C. Z.	F	29	Ulcus callous, recti	Sigmoid	Ø	Normal	Sterile	7	Leucocytes	B. coli	Yes, 2 days	Yes
T. R.	F	68	Ca. colon, transv.	Colon transv.	Ø	Normal	Sterile	14	Leucocytes	Sterile	Yes, 2 days	No
R. M.	M	44	Polyposis recti	Colon desc.	Ø	Normal	Sterile	12	Epithelia	B. coli, B. pyocy-aneus	No	No
L. S.	F	32	Ca. recti	Colon transv.	Ø	Normal	Sterile	14	Leucocytes	Sterile	Yes, 10 days	Yes
B. J.	M	63	Ca. recti	Colon desc.	Ø	Leucocytes	Staph. albus	3	Leucocytes	B. coli	Yes, in-dwelling	Uremia exitus
B. B.	F	72	Ca. recti	Sigmoid	Ø	Normal	Sterile	10	Normal	Sterile	Yes, 3 days	No
S. S.	F	60	Ca. colon, transv.	Colon transv.	Ø	Normal	Sterile	6	Leucocytes	B. coli	Yes, 1 day	Yes
B. T.	M	36	Ca. recti	Colon transv.	Ø	Leucocytes	Sterile	8	Leucocytes	B. coli, B. pyocy-aneus	No	No
G. T.	F	68	Ca. sigmoid	Colon desc.	Nephro-lithiasis	Alb. leu-cocytes	B. coli	8	Leucocytes	B. coli	Yes, in-dwelling	Penetration of ca. into bladder
S. M.	M	64	Ca. sigmoid	Colon desc.	Ø	Normal	Sterile	5	Leucocytes	Staph. aureus	Yes, 2 days	Peritonitis exitus
M. S.	M	40	Ca. recti	Colon desc.	Ø	Normal	Sterile	6	Leucocytes	Staph. albus	No	No
R. S.	F	66	Ca. colon, transv.	Colon transv.	Ø	Leucocytes	Sterile	7	Leucocytes	B. pyocy-aneus	Yes, 3 days	No
M. S.	F	38	Ca. recti	Colon transv.	Ø	Normal	Sterile	9	Leucocytes	B. coli	Yes, 2 days	Yes

Out of a total of 51 patients, accurate urine analyses and bacteriologic studies, including cultures, prior to operation were possible in 42.

Forty of these preoperative cultures were negative, while 2 were positive (*Staphylococcus aureus* and *Staphylococcus albus*, respectively).

Between the fifth and fourteenth postoperative day, urine analyses and bacteriologic examinations were made and cultures prepared in 50 cases; there was a negative result in 7 and a positive one in 43. The sediments of the patients in whom the postoperative urine had not been sterile, almost invariably contained a moderate number of leucocytes, occasionally epithelial cells, rarely casts.

Dr. Gurevitch, head of the bacteriologic department of the hospital, was kind enough to perform the bacteriologic examinations. Among other measures, a gram stain was prepared from every urinary sediment. Where, as in the majority of cases, gram-negative bacilli were found, one loopful of sediment was inoculated upon MacConkey's plate and double sugar. *B. coli* was recognized by its typical growth on MacConkey's plate, and by gas and acid formation on double sugar. Other microorganisms were identified by other routine methods; to give details of these would be of no clinical interest.

The results in the 43 cases with positive postoperative cultures were as follows: *Bacillus coli* in 30 cases, *Bacillus proteus* in 3 cases, *Bacillus pyocyaneus* in 4 cases, *Staph. aureus* in 2 cases, *Staph. albus* in 1 case, mixed infection (*B. coli, B. proteus, B. pyocyaneus*), in 3 cases.

Of the 42 cases of which cultures had been prepared prior to operation, 35 showed postoperative infection.

In the entire group, including the urines which had been found to be sterile prior to operation, the distribution was, therefore, as follows: In 40 colostomies performed on patients with a negative urologic history whose urines had been found to be sterile and to contain no kind of pathologic elements before operation, 33 had positive postoperative cultures. In no more than 6 patients, urine cultures had remained sterile after operation too. In one case (anuria) no postoperative culture could be made.

The 33 positive cultures were distributed as follows: *B. coli* in 21 cases, *B. proteus* in 2 cases, *B. pyocyaneus* in 4 cases, *Staph. aureus* in 2 cases, *Staph. albus* in 1 case; mixed infection (*B. coli, B. proteus, B. pyocyaneus*) in 3 cases.

Twenty of these 40 patients were men, 20 women. The clinical diagnosis was: Carcinoma of the rectum or colon in 33 cases, polyposis recti in 4 cases, benign lesions of the rectum or colon in 3 cases.

Of the 33 patients with positive postoperative urine cultures 17 were men, while 16 were women.

The clinical diagnosis in the 6 cases in which the postoperative cultures were sterile was rectal or colonic carcinoma in 5, and polyposis

recti in 1. Postoperative infection occurred in our patients independent of sex or clinical diagnosis.

Of the 33 patients whose urines had been sterile prior to operation but were afterwards infected, 21 (or 63.6 per cent) had been catheterized after operation for the duration of between 1 and five days. In one case only (persistent retention of urine owing to hypertrophy of the prostate) a permanent catheter had to be employed for ten days.

In contrast to this, in all 6 patients in whom pre- as well as postoperative cultures were negative, catheterization had been employed after operation (between one and ten days, in one case permanent catheter).

Catheterization had been used in 27 out of 40 patients, which is equivalent to 67.5 per cent.

In order to eliminate from our considerations catheterization and the danger it involves on repeated application through transportation of germs into the bladder, as the cause, or at least the principal cause, of postoperative urinary infection in our cases, a control series of 40 patients was set up, selected at random from the surgical wards (including 20 men and 20 women). In these patients who had undergone other abdominal operations (gastric resection, gastroenterostomy, gastrostomy, cholecystectomy, appendectomy, herniotomy), the urine was studied in the same manner as indicated previously.

In all 40, urine cultures were negative prior to operation and remained so after operation in 38. This means that in no more than 2 (or 5 per cent) had infection supervened (in one case *B. coli,* and in one *Staph. aureus*). Catheterization had been employed in 24 cases (or 60 per cent) for the duration of, on an average, 2.5 days. The two patients in whom postoperative cultures were positive belonged to the catheterized group.

Even taking into account the higher percentage of catheterization in patients with colostomies (67.5 per cent as compared to 60 per cent in the control series), the high incidence of urinary infection encountered in that group cannot possibly be due merely to the use of the catheter.

The objection may be made that in the majority of our patients colostomy had been performed because of rectal carcinoma (57 per cent) and that urinary infection should, therefore, rather be considered as a result of the underlying disease than of surgical intervention (colostomy). It is known that a neoplasm growing toward and penetrating into the bladder may lead to urinary disturbances and infection as the result of the migration of germs from the intestinal to the vesical lumen. Disturbed function of the bladder and dysuria have further been reported after extirpation of the rectum (as mentioned previously) and we have also observed it as a very common complication of radical operation for rectal carcinoma.

None of these arguments, however, holds good for our present problem since:

1. None of the tumors operated upon in this series of patients had shown penetration into the bladder. This was verified by the findings presenting themselves on radical operation, as a rule, undertaken two to three weeks after colostomy (one carcinoma of the sigmoid which had penetrated into the bladder cannot be taken into account since in this case urinary infection had already been present before the operation).

2. The tumors, although almost in every case present for months and having caused distinct clinical symptoms, had not led to urinary disturbances or infection until the day when colostomy was performed (as was seen from the negative preoperative urologic histories, urine analyses, and cultures).

3. In our series of patients in whom colostomy was only a provisional measure, the factors reported to be responsible for urinary complications after rectal operation (injury to bladder, displacement by separating it from its posterior fixation, injury to innervation, penetration of germs from the sacral wound area or introduction of germs by way of the external urethral orifice) can be ruled out.

4. The reaction of the few patients in whom colostomy had been undertaken on account of benign lesions did not differ essentially, as to postoperative appearance of urinary infection, from that of individuals colostomized because of malignant new growths.

In the entire selected group of 40 patients, preoperative urine cultures had been negative. If in 33 of them (that is, in 82.5 per cent) postoperatively, that is, after the same surgical manipulation had been performed on all of them, urinary infection announced itself by positive cultures, *a causal interrelationship between this operation (colostomy) and urinary infection must be presupposed.*

How is it that simple colostomy may lead to urinary infection? That the occurrence of infection is in some way or other connected with the colon must be deduced from the fact that the vast majority of the postoperatively infected patients showed pure or mixed cultures of microorganisms belonging to the normal colonic flora (as *B. coli, B. proteus*).

How should this traveling of germs from the intestinal to the urinary tract be imagined to take place? And what is the role colostomy plays as a causative factor in this transport?

It is generally understood that *B. coli* is the most common organism causing urinary infection (70 to 80 per cent) and it is, therefore, generally assumed that infection must necessarily start from somewhere in the colon.

The route by which the germs may travel is still obscure but facts point to the possibility of their getting into the urinary tract inside the organism after absorption from the intestinal tract. Such a migra-

tion may take place in three ways: (1) by continuity, that is, by directly spreading through the tissues, (2) by the hematogenous route, or (3) by the lymphogenous route.

The first mentioned possibility must be considered wherever contact is established between the intestinal and the urinary tract by pathologic lesions (for example, by an inflamed retrocecal appendix with adhesion to the right ureter, adhesions between colon and bladder owing to diverticulitis, or, as already mentioned, penetration of rectal new growths into the bladder).

A number of authors hold the hematogenous route responsible for the presence of *B. coli* in the urine. Thus, Heitz-Boyer found "showers of colon bacilli" in the urine of certain patients, occasionally without pus (!), and in his opinion minute defects of the mucous membrane of the large intestine, usually associated with reduced intestinal motility, give the germs an opportunity of getting into the blood stream, to be later eliminated through the kidneys (the "enterorenal syndrome" of French authors).

Others give prominence to the mesenteric lymph nodes as an important depôt for the accumulation of *B. coli*. In 50 per cent of the mesenteric lymph nodes of dogs with a normal intestinal tract, David and McGill found bacilli preponderantly *B. coli*. This very definitely indicates the possibility of the passage of bacilli from the normal intestine to the mesenteric lymph nodes. Where the intestinal wall was, however, exposed to additional trauma or the lumen obstructed, the number of bacteria in the mesenteric lymph nodes could even be increased. After increasing the concentration of bacteria in the intestinal tract, David and McGill recorded the appearance of *B. coli* in the urine of 3 out of 11 dogs. They hold that in almost every individual a small number of *B. coli* passes into the blood stream without producing pathologic symptoms.

If even more bacilli are given the opportunity of gaining entrance into the blood stream by injury to the intestinal wall or reduced intestinal motility, this coliuria may reach a degree to be clinically evident.

Solis-Cohen found, in female patients, colibacilluria during attacks of gastroenteritis.

Leishman draws attention to the clinical relationship between colonic function and coli-infection of the urinary tract, particularly stressing the etiologic significance of constipation for many cases of coliuria.

Thirty per cent of Kretschmer's patients presenting renal coli-infection was suffering from constipation.

According to Turell, a colon in which normal function has been disturbed may serve as a portal of entry for enteric organisms into the blood and the lymph channels, and may eventually account for urinary infection in a number of cases.

Fecal stasis as well as inflammatory lesions of the rectocolon may, in his opinion, produce and maintain mild or subacute types of urinary infection with bacilli of the coli group.

Thus, Peretz and his co-workers found among 17 cases of coli-infection, 15 in which the uro-infection was associated with intestinal dysfunction.

Baehr, Shwartzman, and Greenspan found evidence of similar relations in connection with *B. Friedländer* infection of the urinary tract, and Neter for infection with *Bacillus dysenteriae*.

French authors advocate a search for an intestinal etiology in every case of coliuria (see the so-called enterorenal syndrome), and a grouping of the patients according to presence of definite intestinal lesions, constipation, or absence of intestinal symptoms.

Three factors are, therefore, unanimously considered as the possible cause of coli-infection of the urinary tract of an intestinal origin: (1) the reduction of normal intestinal motility, (2) fecal stasis, and (3) defects of the intestinal wall.

In our opinion, the performance of colostomy, particularly since it is usually undertaken for the relief of obstruction of the intestinal lumen, is sufficient to set in motion all three of these factors.

Fecal stasis may, in a number of cases, already have been present prior to the operation and until the lumen of the eventrated loop is actually opened, it may even transitorily be considerably increased.

Reduction of intestinal motility is the natural consequence of the eventration of intestinal portions and the manipulations connected with this procedure.

Injury to the intestinal wall, although it may be avoided during the eventration of the loop by abstaining from laying stitches through the bowel wall itself, must necessarily occur when the lumen is opened and the colostomy made to work.

Whether in the particular case the microorganisms of the coli-group travel through the intestinal wall directly to the blood stream or whether this occurs via the mesenteric lymph nodes with eventual elimination through the kidneys is as yet imperfectly understood. The detection of *B. coli* in the blood is very difficult and in none of our patients in whom blood cultures were made was it possible to obtain positive findings.

Clinically, the course of the majority of the infections in our patients was mild, some of them showing no symptoms at all. Moderate elevation of temperature, dysuria, leucocytes in the urinary sediment were the most common symptoms. No case of acute purulent pyelitis with high temperature, chills, etc., was observed in this group. The majority showed satisfactory response to chemotherapy (sulfanilamides, or mandelic acid) and were free of symptoms after a short time.

Further follow up of the urinary conditions was of no avail, since in the majority of cases colostomy was followed, after two to three weeks, by radical operation for the primary lesion (in most cases sacral extirpation of the rectum), a procedure which, as already pointed out, may in itself cause numerous urinary complications.

SUMMARY

The high incidence of postoperative urinary complications in patients on whom, for varying reasons, simple colostomy had been performed led us to study systematically a series of 51 colostomies.

In addition to data of a general character and the urologic histories, accurate urinary analyses and bacteriologic studies of sediments and cultures were made and pre- and postoperative data compared (Table I).

In a group of 40 especially selected patients in whom the urologic histories had been negative and whose urines had been found to be sterile and free from pathologic elements prior to operation, 33 (or 82.5 per cent) showed positive postoperative cultures (namely in the vast majority *B. coli*).

The question arising as to the existence of a causal interrelationship between colostomy and urinary infection is discussed.

On perusal of the literature, we have found no reference to uro-infection after colostomy.

REFERENCE

1. Baehr, G., Shwartzman, G., and Greenspan, E. B.: Ann. Int. Med. **10**: 1788, 1937.
2. David, V. C., and McGill, E. C.: J. Urol. **10**: 233, 1923.
3. Heitz-Boyer, M. F.: Quoted in Turell.
4. Hill, M. R., Barnes, R. W., and Courville, C. B.: J. A. M. A. **109**: 1184, 1937.
5. Kretschmer: Quoted in Turell.
6. Leishman, A. W. D.: Lancet **2**: 971, 1939.
7. Neter: Quoted in Turell.
8. Peretz, L. H., Shapiro, J. N., Chomjenko, T. A., and Ptochoff, M. M.: Ztschr. f. urol. Chir. u. Gynäk. **41**: 262, 1935.
9. Solis-Cohen, M.: Urol. & Cutan. Rev. **40**: 231, 1936.
10. Turell, R., and Marino, A. W. M.: J. Urol. **42**: 197, 1939.
11. Turell, R.: Am. J. Digest. Dis. **6**: 312, 1939.
12. Turell, R.: J. Urol. **43**: 476, 1940.

RECTAL AND COLONIC COMPLICATIONS OF PELVIC IRRADIATION

HERBERT I. KALLET, M.D., F.A.C.S., AND M. JORDAN THORSTAD, M.D.
DETROIT, MICH.

FOLLOWING irradiation of the cervix or other pelvic organs, complications involving the rectum and lower colon may occur. These sequelae present serious and ofttimes perplexing diagnostic and theraapeutic problems.

Just what proportion of patients receiving pelvic irradiation develop colonic complications is hard to estimate. The nature of the initial lesion, its radiosensitivity, the technique of application, the skill of the radiologist, and individual susceptibility all are factors. Buie and Malmgren[1] report the incidence as 3 per cent; whereas Wigby[2] places the figure as high as 57 per cent. It seems agreed that colonic injury is more likely to follow irradiation to the cervix than to other pelvic structures.

Radiation therapy for carcinoma of pelvic organs is an accepted procedure, and with present techniques it may be impossible at times to avoid injury to other organs which lie in close proximity. The serious nature of the original disease justifies the risk of complications which may follow. However, before irradiation treatment of benign conditions which are amenable to surgery is recommended, the question of secondary damage to the intestine must be carefully considered.

PATHOLOGY

Radiation unfortunately produces changes in normal as well as pathologic cells. Injury to the connective tissue and blood vessels first exhibits itself in the form of edema. With further trauma, an endarteritic process develops with thickening of the walls and gradual decrease in size of the lumen.

Damage to the endothelial lining induces thrombosis and occlusion with infarct formation. The infarcted tissue is replaced by fibroblastic scar which gradually undergoes sclerosis and hyalinization. Both striated and smooth muscle cells are also destroyed by heavy irradiation and are replaced by connective tissue.

The rectal and intestinal mucous membranes are very sensitive to the action of these destructive rays. The anatomic proximity of the lower intestine to the uterus places it within sharp radiation focus when the cervix is treated.

Received for publication, March 2, 1944.

The complicated sclerosing process tends to progress as months go by. Hardening and shrinkage of the posterior pelvic and parametrial tissues takes place. A firm mass may thus be formed below the utero-cervical junction which extends backward to the second and third sacral vertebrae. Ensnared in this fixed mass may be the vagina, the ureters, and the rectum. The vagina becomes stenosed and deformed; obstruction of the ureters may occur and frequently the rectum or sigmoid becomes stenosed.

For convenience the sequelae may be grouped as follows:

1. Radiation proctosigmoiditis
2. Entrapment
3. Extension
4. Fistula formation

These may occur singly or in combination.

RADIATION PROCTOSIGMOIDITIS

The most common intestinal complication following irradiation is proctosigmoiditis. This may vary in intensity from simple irritation to deep eschar formation. Symptoms may set in shortly after the radium insertion, reaching maximum severity six or eight weeks later. There is diarrhea with increased mucus, the stools assuming a frothy character. Abdominal cramps and a tenesmus are present, and the act of defecation gives incomplete relief. Scant amounts of blood may be found in the stool, but gross hemorrhage is uncommon.

The fecal discharges are acrid and irritating to the perianal skin. Thrombi may form in one or more of the external hemorrhoidal veins. Hemorrhoids which may have pre-existed tend to become aggravated and cracks or erosions about the anus may occur. Marginal or ischiorectal abscesses may develop with subsequent fistula formation.

On digital exploration the sphincters will usually be found spastic. Indeed, it is often necessary to inject a local anesthetic or apply a topical analgesic before a proper examination can be made.

The proctoscopic picture varies with the degree of injury. Early, the mucosa appears edematous and much mucus will be seen. The membrane is hyperemic and traumatizes easily. Petechiae may be present. Later, in more severe involvement, patches of eschar will be visualized, yellow-white plaques sometimes an inch or more in diameter. These eschars, or factitial ulcers as Buie and Malmgren term them, may arise anywhere along the focal lines of radiation, but most commonly appear on the anterior rectal wall at the cervical level. They may be found on a valve but this is not constant.

The discomfort caused by this form of proctitis is great and the patient may be very miserable. The first point in treatment is to recognize that the intestinal disturbance is due to the radiation and not to malignancy of the bowel itself. The patient must be reassured and

consoled with the prognosis that the symptoms, although disagreeable, are usually temporary.

Rest is essential, both physical and mental. A diet that is adequate but nonirritating should be prescribed. Some sort of sedative will be necessary. Codeine given at regular intervals will both relax the patient and quiet the intestine. It is more effective than the barbiturates and less habit-forming than other opiates.

Much of the tenesmus is due to sphincter spasm and irritation of marginal anal lesions. The injection of one of the oil-soluble anesthetics such as eucupine, propalcain, or anucaine will often give quick and prolonged relief. If necessary the injection may be repeated later.

Irrigations and colonic flushes may do more harm than good. Local therapy if applied should be mild and nonirritating. Cod-liver oil, instilled once or twice daily, is soothing and seems to hasten resolution. It is best given in the knee-chest position morning and night. One ounce is administered at first and the amount increased as the patient is able to retain it.

An occasional individual may not tolerate cod-liver oil well. In that instance, the oil may be diluted with one of the common cooking oils, as Mazola or Wesson, or the cooking oil alone may be substituted.

The possibility of a fecal impaction should always be borne in mind. The pain of bowel movement and sphincter spasm may cause the patient to withhold complete defecation and the frequency may be deceptive. The presence of these impactions adds trauma to the already injured mucosa and ulcers may occur. In cases tending to impact, petrogalar enemas are of value. The agar-oil emulsions mix well with water and are more effective than oil alone.

Drugs forming a protective bowel coating, such as bismuth or kaolin, may also at times find indication. General supportive measures, such as vitamin preparations, iron, and the like, are useful therapeutic adjuncts.

In favorable cases the reaction gradually although slowly, subsides; the eschars resolve and the intestine regains normal function. The damaged mucosa, however, tends to traumatize readily and drops of blood may appear in the stool for many months. Indeed, it may never entirely disappear. Sometimes the superficial capillaries will be seen to form patchy areas of telangiectasis.

ENTRAPMENT

A serious sequel to irradiation is a stenosis of the sigmoid or upper rectum as the bowel is compressed by the firm fibrotic mass of the frozen pelvis. This entrapment takes place slowly over a period of months and even years, with the development of an intestinal obstruction of increasing severity. The stenosis is ordinarily palpable by digital examination. Occasionally it is only visualized by sigmoidoscopy or demonstrated by x-ray study.

The symptoms are those of increasing constipation; the patient complaining of the feeling of incomplete evacuation. Bowel movements may be preceded or accompanied by lower abdominal pain. The constipation is at length supplanted by a diarrhea of a paradoxical type, the patient having frequent small, unsatisfactory movements. Incontinence of stool may ensue, necessitating the wearing of a pad. Periods of fever and increasing lower abdominal pain indicate inflammatory change above the stricture. Pus then may be found in the feces and blood may be present.

As in all cases of chronic intestinal obstructions, there is gradually induced ill health. Because of the location of the stenosis in the terminal bowel, the toxemia develops more slowly than in proximal colon disease. There is lack of appetite, anemia, loss of weight, vague pains, and abdominal distress. This clinical picture occurring in an individual known to have had carcinoma is easily misinterpreted as an indication of metastasis. An early recognition of the benign nature of the stenosis changes the prognosis to a more favorable one.

The treatment of the entrapment depends upon the degree of stricture and the general condition of the patient. If the passage, although narrowed, is adequate, a low residue diet and the regular administration of mineral oil may prove successful. Phosphate of soda given before breakfast about twice a week offers much relief.

When the obstruction is more severe, laparotomy must be done. It will sometimes be possible to free the entrapped bowel from the mass of adhesions. More often, however, colostomy must be performed.

EXTENSION

Whenever rectal symptoms develop, the question at once arises: Has extension or metastasis of the growth taken place? It is quite possible for the initial lesion in the cervix or elsewhere to resolve completely after irradiation, yet invasion of the bowel wall be present. The neoplasm may advance through the rectovaginal septum or extend laterally along the peritoneum of the posterior abdominal wall.

In the latter instance, pain is generally a principal symptom. It is severe, neuralgic in character, radiating down the left sciatic distribution. The pain in septal invasion is apt to be less marked.

Digital examination and sigmoidoscopy will usually differentiate recurrence of malignancy from the pseudocarcinoma brought about by inflammation and fibrosis. In recurrence the mass is more localized. It is raised and often polypoid, unlike the smoother stenosis of entrapment. Sometimes a definite mucosal involvement can be seen; at other times, the new growth is deep and submucosal. Biopsy is, of course, the most accurate means of differentiation. An adequate specimen can in most cases be secured by punch through the proctoscope.

When recurring carcinoma is found, the radiologist must consider whether or not further irradiation is advisable. Here the possibility of factitial ulceration and the development of rectovaginal fistula becomes great. It is well in these recurrences to recommend colostomy early, both to avoid pain and to lessen the chance of fistula formation.

Resection of the rectum is occasionally possible; particularly so when the rectovaginal septum has been invaded.

FISTULA FORMATION

The development of rectovaginal fistula is a most distressing sequela. It may result from infarction brought about by destructive action of the radiation or as a result of secondary infection. The fistulas may vary in size from pin-point openings to large defects. In small fistulas, relief may be secured by constipating the patient; the dry formed stool being unable to leak through the perforation.

Most patients with rectovaginal fistulas of this nature will require colostomy. It is difficult to undertake plastic closure as the blood supply is inadequate and healing delayed. Following colostomy posterior resection may be considered.

CASE REPORTS

The following case histories illustrate some of the problems.

CASE 1.—Mrs. J. L., 47-year-old white woman, was admitted to Harper Hospital, September, 1942, with a history of uterine bleeding of several months' duration. Biopsy of the cervix revealed an early squamous-cell carcinoma. She received 3,000 r units of x-ray therapy and 5,400 mg. hours of radium.

Shortly after her return home, she developed a diarrhea which became increasingly severe and there was excruciating rectal pain. Weight loss, weakness, and loss of appetite were present. In January, 1943, she was returned to the hospital. At that time, there was noted a deep undermining ulcer at the posterior anal commissure. Proctoscopic examination showed an acute inflammatory reaction to be present, extending well up into the sigmoid.

The sphincter was injected with 5 per cent eucupine in oil, some of the solution being infiltrated under the ulcer. Daily instillation of cod-liver oil was started and codeine was given at four-hour intervals. The progress of the patient was excellent; the pain subsided and the diarrhea lessened. Her appetite returned and after two weeks she returned home. Her improvement, to date, has been progressive.

CASE 2.—Mrs. T. R., a white woman, 48 years old, was treated for squamous-cell carcinoma of the cervix in July, 1935. At that time she was given 3,960 mg. hours of radium and 3,000 r units of x-ray. She was readmitted to the hospital February, 1936, because of pelvic pain and vaginal discharge and given 4,500 r units of deep therapy and 3,600 mg. hours of radium.

The patient was followed in the clinic regularly every six months. In March, 1943, she had symptoms of intestinal obstruction. Examination showed the sigmoid to be entrapped as described previously. Laparotomy was done and the rectum freed from a mass of fibrous adhesions. This was followed by rectal dilations. Her progress, to date, has been good.

CASE 3.—Mrs. H. L., a white woman, aged 43 years, was given a course of radium and deep therapy in the fall of 1941, for a rapidly growing squamous-cell carcinoma of the cervix. The growth resolved readily and the patient improved until the early part of 1942, when there developed diarrhea and excessive mucus in the stool. The diarrhea gave way to constipation and the patient was obliged to take almost daily enemas. Pain was severe and tended to radiate down the left leg.

Examination showed the cervical growth to be healed. There was an indurated area on the anterior rectal wall about one inch in diameter, at about the level of the cervix. The patient was admitted to Harper Hospital where a biopsy was taken. The tissue demonstrated ulcerating bowel wall with chronic inflammation. There were carcinoma cells in the deep scar tissue.

The patient was given 1,200 mg. hours of radium intrarectally and 4,000 r units of deep therapy. In August, 1942, another course of deep therapy was given. There was severe pain on bowel movement and the rectum showed extensive eschar and stenosis. In October, 1942, a colostomy was performed. The pain and distress was markedly improved. However, there was bleeding from the posterior vaginal wall and eventually a fistula formation between the middle of the rectum and the vagina.

Fig. 1 (Case 2).—The sigmoid is caught in a mass of postradiation scar but no metastasis is present.

The patient is alive, at the time of this communication, and there is no recurrence noted. The rectovaginal fistula is still present and should the patient survive for another year or more a resection of the rectum and posterior vaginal wall may be considered.

CASE 4.—Mrs. L. L., a white woman, aged 42 years, presented herself June 24, 1938. Three months previously carcinoma of the right ovary had been removed. At the time of surgery many metastatic nodules were present on the parietal peritoneum, and the mass was adherent to the sigmoid.

Following surgery she was given a course of deep therapy. A period of diarrhea followed which gave way to constipation, and for two weeks she had been unable to have adequate bowel movement. Pain was present in the lower abdomen and back, radiating down the left leg. X-ray examination showed an almost complete obstruction at the upper sigmoid.

The symptoms of obstruction continued to become more severe and October 6, a colostomy was performed. Abdominal exploration demonstrated a large carcinoma in the sigmoid which was entrapped in a mass of pelvic fibrosis. Numerous metastatic nodules were present in the uterus.

The patient lived until Feb. 5, 1939, when she died suddenly with convulsions, probably due to cerebral metastasis.

Fig. 2 (Case 4).—The sigmoid presents a marked stenosis as the result of both new growth and fibrosis.

CONCLUSIONS

1. Injury to the sigmoid and rectum occurs frequently following irradiation of the cervix and other pelvic organs.

2. The sequelae may be manifested as:

   a) Proctosigmoiditis
   b) Entrapment
   c) Extension
   d) Fistula formation

3. The complications of irradiation give a clinical picture which may be misinterpreted as metastasis or extension of the original disease.

4. Relief of symptoms may often be obtained by suitable medical and surgical management.

REFERENCES

1. Buie, L. A., and Malmgren, G. E.: Factitial Proctitis, Internat. Clin. **3**: 68, 1930.
2. Wigby, Palmer E.: Post-irradiation Stricture of Rectum and Sigmoid Following Treatment for Cervical Cancer, Am. J. Roentgenol. **49**: 307, 1943.

REPORT OF CASE OF RETROPERITONEAL HEMANGIOENDOTHELIOMA

T. J. Snodgrass, M.D., Janesville, Wis.

(From the Pember-Nuzum Clinic)

RETROPERITONEAL sarcoma is sufficiently rare and the difficulties encountered in the diagnosis and treatment of the disease are such that the report of a single case is extremely helpful. Many excellent reviews of the literature, together with reports of single cases or a small series of cases are available. Therefore, no attempt will be made to present such a review.

It is generally emphasized that the symptoms are indefinite because of the slow growth of the tumor so that it may pass unnoticed until pressure symptoms occur. The constant signs are low-grade fever, loss of weight, secondary anemia with degenerative changes or hemorrhage in the tumor, leucocytosis, and tenderness. If the tenderness occurs on the right side, it may simulate appendicitis. In addition to palpation of the tumor, it may be outlined by routine x-ray examination of the gastrointestinal and genitourinary tracts; if of sufficient density, its structure may be visualized on a flat plate.

Some of these tumors have attained enormous size. Hirsch and Wells* reported a liposarcoma weighing sixty-nine pounds—part was removed at operation and the remainder at autopsy. Judd and Lassar (1933, Mayo Clinic) in their series of forty-six cases, listed in order of frequency pure sarcoma, fibrosarcoma, lymphosarcoma, myxosarcoma, liposarcoma, myosarcoma, and paragangliosarcoma.

One is impressed with the fact that the only successful treatment of these tumors is complete surgical extirpation, combined with radium and x-ray. In the active stage of the disease, surgery is extremely hazardous, so much so that one experience is enough to make one wary about ever attempting to operate upon another patient with such a tumor. The case reported here is extremely interesting because from its behavior and the preliminary tissue examination, a diagnosis of sarcoma was made, but in the final examination of the specimen, it proved to be of much lower degree of malignancy and a type unlike those reported in my limited review of the literature.

CASE REPORT

Mrs. S. S. (No. 3189), aged 51 years, was admitted to the clinic for the sixth time, Jan. 6, 1942. The week before she had had a chill and cold sensations, with

Received for publication, Oct. 1, 1943.

*Hirsch, E. F., and Wells, H. G.: Retroperitoneal Liposarcoma, Am. J. M. Sc. 159: 356, 1920.

temperature ranging from 100 to 101° F., controlled by acetylsalicylic acid; she was nervous and fatigued and had slight pain under the ribs on the left side. Her weight was 157 pounds; pulse, 100; throat, red; she had small polyps in the stump of cervix (subtotal hysterectomy, 1928); mild proctitis; internal hemorrhoids; tenderness in right lower quadrant; few pus cells in the urine.

The cervix was cauterized and the patient improved and was not seen again until two months later, March 12, 1942. Again she had been sick for a week, but up and around. Temperature was 100° F.; there was pain in the right lower quadrant, with no tenderness; few pus cells in catheterized specimen of urine; hemoglobin 70 per cent; white blood cells 15,750; Widal negative. The following day, March 13, temperature was higher; white blood cells 22,300; hemoglobin 75 per cent; 53 segmented cells and 22 stabs. A tender mass was found halfway between the iliac crest and the lower ribs on the right. She was up and around, and had neither nausea nor vomiting.

The patient entered Mercy Hospital March 13, was given sedatives and sulfanilamide, and her progress was observed. The leucocyte count varied from 14,000 to 19,000. The temperature ranged from 99.8 to 101.8° F. The mass decreased in size daily, as checked by skin marking.

On the night of March 18, the mass suddenly increased in size. The leucocyte count increased, and exploration was done on the morning of March 19. A huge retroperitoneal mass was found extending down below the anterior iliac spine over to the umbilicus and up underneath the liver on the right. The tumor appeared hemorrhagic. Aspiration biopsy was performed. The aspirated material consisted of blood and very small particles of tissue. Several smears were prepared and the pathologist considered the specimens unsatisfactory, although he entertained a diagnosis of myxosarcoma or sympatheticoblastoma. The wound was packed and later closed. There was a rapid drop in hemoglobin requiring repeated blood transfusions. Cystoscopy with retrograde pyelogram on the right (Fig. 1) outlined the tumor, but showed no pathology in the kidney. Scout film (Fig. 2) showed a large, indefinite mass on the right side of the abdomen.

After consultation, the idea of surgical removal was dismissed. Deep x-ray therapy and Coley's toxins were immediately started. During this period, the patient required blood transfusions. She left the hospital April 26, x-ray treatments up to skin tolerance, 6,000 r being continued. Her condition improved remarkably; the mass decreased in size. The hemoglobin increased and the leucocyte count dropped. Early in June x-ray examinations were repeated. With the aid of scout films the tumor was visualized, showing a well-encapsulated mass of irregular density (Fig. 3). Intravenous pyelogram outlined the tumor (Fig. 4), and barium enema showed the displacement of the right hepatic flexure of the transverse colon downward (Fig. 5). The patient improved so remarkably, and the tumor became so firm and well circumscribed that it appeared that surgical removal was entirely possible and offered the only chance for complete eradication of the disease.

June 30, 1942, another surgeon concurred in this view and agreed to attempt surgical removal, just three and one-half months after the appearance of the tumor. The following is his consultation and operative record: Mrs. S. S., was seen before, and our impression was that she had a retroperitoneal tumor, the origin of which was unknown. Her general condition was good, and in view of this an exploration was advised. The exploration was carried out under general anesthesia June 30, 1942, and a routine type of kidney incision was made on the right side. The tumor was located, and it reached below the crest of the ilium and up almost to the costal margin and was retroperitoneal. By blunt and sharp

dissection the tumor was isolated. The bleeding points were caught and ligated. The peritoneal cavity was entered, and in the course of dissection it developed that the tumor was derived from the outer aspect of the right kidney. After removal of the tumor, the kidney was damaged; and, because of the possibility of tumor tissue still being present and of damage to the kidney cortex, the right kidney was removed. The peritoneum was closed with interrupted chromic gut. A small Penrose cigarette drain was inserted in the lower end of the wound in the flank, and the wound was closed in layers. The postoperative diagnosis was probably a hypernephroma.

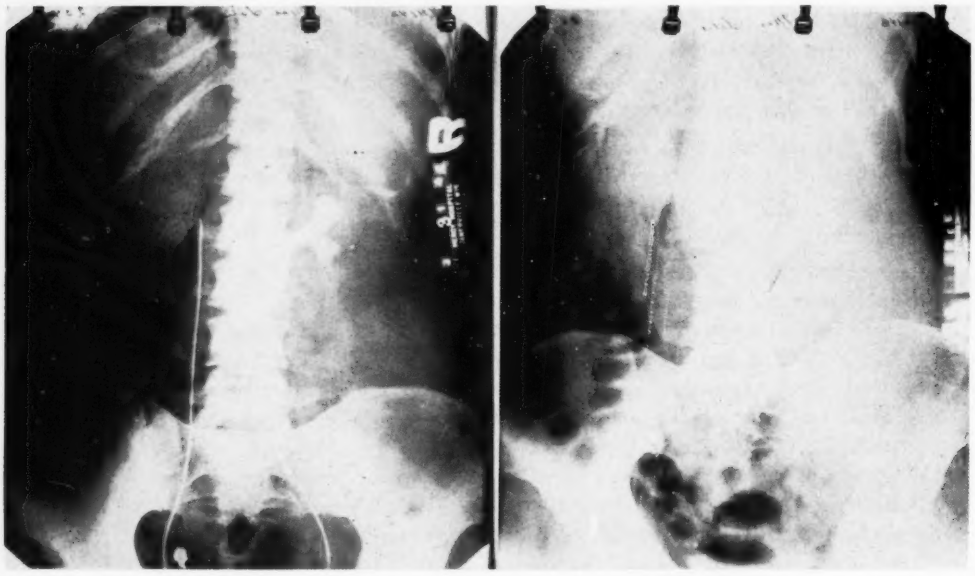


Fig. 1. Fig. 2.

Fig. 1.—Retrograde pyelogram showing displacement of kidney and ureter toward the midline (March 31, 1942).

Fig. 2.—Scout film showing loss of psoas shadow on the right and large indefinite mass (March 31, 1942).

The tumor was firm and well encapsulated and appeared to be completely excised. The patient made a rapid recovery.

The following pathologic report was submitted: One specimen was a large encapsulated tumor measuring 50 by 10.3 by 7.5 cm. and weighing 480 Gm. The capsule incorporated adipose tissue. One surface of the tumor was rough and contained a small piece of adherent renal tissue which measured approximately 4.5 cm. in length, 6 to 18 mm. in width, and 1 to 3 mm. in thickness. Upon sectioning, the tumor showed pronounced necrosis and a variety of colors—brown, dark yellow brown, light and dark yellow, black, and various tints of red. The brown areas were firm and brittle. The yellow areas were soft and suggested the presence of adipose tissue. The tumor in places was somewhat lobulated. The second specimen was a kidney measuring 11.5 by 6 cm. and ranged in thickness from 1.5 to 3 cm. It weighed 120 Gm. The kidney was somewhat flattened and on one side it was slightly concave. The concave surface contained a rough area which apparently represented the attached portion to the described tumor. The capsule was thickened and partly stripped away. The surfaces were granular and contained markings of fetal lobulations. The renal artery was slightly thickened.

Fig. 3. Fig. 4. Fig. 5.

Fig. 3.—Scout film outlining the tumor (May 19, 1942).
Fig. 4.—Intravenous pyelogram and shadow of tumor on the right (June 19, 1942).
Fig. 5.—Barium enema showing displacement of the colon to the left (June 19, 1942).

Microscopic examinations revealed a malignant neoplasm composed of numerous somewhat thick-walled blood vessels of the arteriolar size. These vessels were surrounded by cuboidal and cylindrical cells which appeared to arise from the

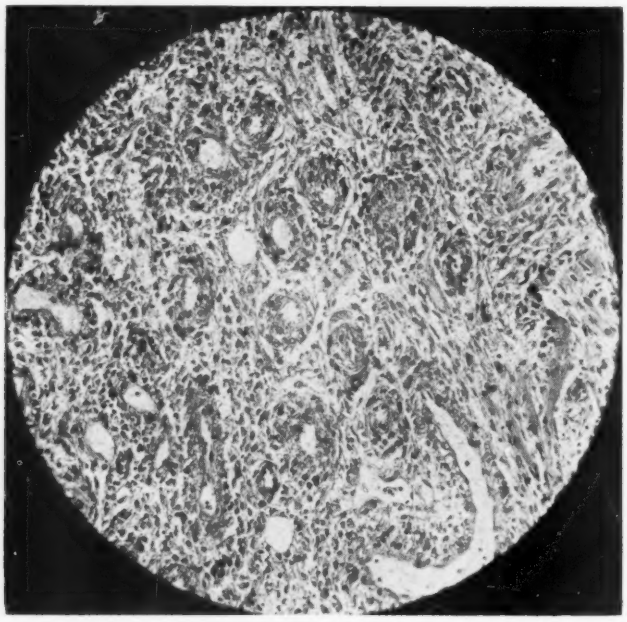


Fig. 6.—Low-power magnification of hemangioendothelioma (plexiform angiosarcoma) revealing numerous vessels and radiating perithelial cells.

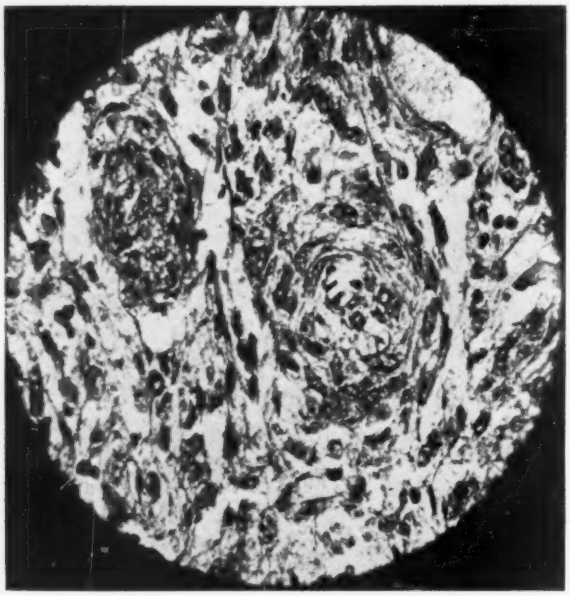


Fig. 7.—High magnification of hemangioendothelioma.

vessel wall. Other vessels were of capillary size and still others were large, thick, and contained areas of hyalinization and myxomatous changes. Neoplastic cells radiated from both the small and large vessels. There was a moderate amount of

intervening adipose tissue in some sections. In one area there were many collagenic fibers in which neoplastic nuclei were present. In a few areas there was considerable pleomorphism of the nuclei. Some nuclei were giant forms and a few were multilobed and multinucleated. Mitotic figures were occasionally encountered. The tumor was well encapsulated. Two of the sections showed renal tissue adherent to the capsule. There was no evidence of invasion of either the renal capsule or parenchyma. Sections of kidney revealed slight interstitial fibrosis. The interlobular arteries were thickened and a few contained occluded lumens. The Bowman's capsules of some of the glomeruli were thickened. Diagnosis: Retroperitoneal hemangioendothelioma; renal arteriosclerosis, grade I.

The patient left Mercy Hospital July 12, 1942, and a second series of x-ray treatments (3,600 r) was started August 17, and completed Sept. 5, 1942. A second course of Coley's toxins was given at the same time. The patient had a severe skin reaction following the second series of x-ray treatments. Fourteen months after the removal of the tumor, the patient was in good health and without evidence of recurrence.

There are several interesting observations about this case. The presence of fever and leucocytosis during the period of activity was probably due to degenerative changes in the tumor itself, simulating appendicitis with abscess formation. With hemorrhage into the tumor, there was a rapid drop in hemoglobin out of proportion to the blood loss, some of which might have been due to the sulfanilamide. The response to x-ray and Coley's toxins was sufficient to cause a regression of the tumor and, with it, a drop in the leucocyte count and an increase in the hemoglobin. This response was not sufficient to give any assurance that complete regression would take place, or that cure would result without excision of the tumor. The final pathologic diagnosis gives a good prospect for permanent cure.

FOREIGN BODY IN THE THYROID GLAND

Case Report

Herbert T. Wikle, M.D., and Thomas Spellman, M.D.
Brooklyn, N. Y.

SEVERAL cases of foreign bodies in the thyroid gland have been reported in the literature.[1-5] However, the following case report illustrates an unusual body and is of particular interest because of the length of time it had remained in the gland without causing any reactions that could be specifically referred to it.

A 38-year-old white American housewife was admitted to the surgical service of the Cumberland Hospital, March 8, 1939, complaining of a tumor of the anterior portion of the neck, which existed for twenty-six years prior to admission.

Coincident with the onset of menstruation at the age of 12, the patient first noticed an enlargement of the neck, anteriorly. Because of moderate but persistent increase in the size of the tumor, at the age of 15 years (or twenty-three years prior to present hospitalization) the patient underwent two operations, five months apart, in a New Orleans hospital. The operative procedures were followed by some diminution in the size of the neck tumor. Five years later, when the patient was 20 years old, the growth began to increase in size and continued to do so until admission to the Cumberland Hospital. She complained of moderate orthopnea and dyspnea on exertion. She did not have any symptoms of thyrotoxicosis, and, as a matter of fact, had gained twenty-five pounds during the past year.

The patient was pregnant thirteen times, eight pregnancies resulting in normal full-term deliveries, and five in spontaneous abortions. During the years prior to 1939, she noticed a moderately pronounced metrorrhagia and menorrhagia.

The remainder of the patient's history, and her family history, was negative. Physical examination at that time showed a well-developed, moderately overweight white woman. There was no exophthalmos. There was a large thyroid tumor the size of a grapefruit, which filled the entire anterior part of the neck and extended on both sides into the posterior triangle of the neck. The mass was somewhat larger on the left side. The tumor was firm and showed several small nodules. There were two old healed operative scars, one on each side of the neck over the midportion of the sternocleidomastoid muscle, and apparently the sites of the thyroid pole ligations done twenty-three years before.

The blood pressure was 184/124; pulse rate 100 per minute and regular. The heart showed some enlargement on the left side and a loud systolic murmur was heard over the entire precardium. Pelvic examination revealed a fibromyomatous uterus, the size of a four-month gestation.

The laboratory findings were as follows: Blood count and urinalysis were normal aside from a trace of albumin in the urine; blood sedimentation time was forty minutes to 18 mm.; blood cholesterol was 204 mg. per cent; blood sugar 111 mg. per cent; blood urea nitrogen 13 mg. per cent, and blood uric acid 4.1 mg. per cent;

Read at a meeting of the Brooklyn Surgical Society, May, 1943.
Received for publication, Feb. 18, 1944.

Wassermann reaction negative; basal metabolic rate plus 13; electrocardiogram showed fairly normal curves. Chest roentgenogram showed the lungs to be clear and a cardiac enlargement was interpreted as hypertrophy and dilation associated with aortitis. Roentgen-ray examination of the neck was reported as showing the presence of a very large soft tissue opacity lying in front of the trachea and measuring 8 c.c. in anteroposterior diameter and 14.5 cm. in transverse diameter. A few small specks of greater density noted throughout the soft tissue mass were said to be indicative of cartilagenous changes.

Fig. 1.—Needle in two pieces pointing anteriorly.

March 14, 1939, six days after admission, a subtotal thyroidectomy was performed under cyclopropane anesthesia. The usual transverse incision was made. A large amount of scar tissue was encountered on both sides adjacent to the previous operative scars. The ribbon muscles were markedly thinned and distorted. During the dissection and following ligation of both superior poles, a portion of the median aspect of the left lobe was found to be extending retrosternally. After this was delivered into the wound, a sharp object was palpated in the fascia, just below the suprasternal notch. This was removed and found to be an old cutting edge needle in two parts, the major one measuring 1.5 cm. in length. The smaller cor-

roded piece was removed from the thyroid gland at the same level. It is interesting to note at this time that the needle was discovered just below the suprasternal notch, yet the previous two operative scars were located in the midportion of the neck on each side. The left lobe was removed except for a posterior shelf. Because the patient's general condition was not entirely satisfactory following the necessarily extensive dissection, about two-thirds of the right lobe were left in situ and the wound was closed in the usual fashion.

The patient's postoperative course was fairly uneventful except for considerable serous discharge from the wound. Blood pressure, which was 184/124 on admission, returned to normal after the operation and remained there. She was discharged on the twenty-fifth postoperative day.

The removed thyroid was an irregular nodular mass which weighed 430 Gm. and measured 14 by 8 by 6 cm.

Pathologic diagnosis was colloid goiter with hyalinization, cholesterinization and calcification (nontoxic nodular goiter).

Second Admission.—The patient was readmitted ten months after discharge for further surgery. During the interim since the last operation, she had no complaints other than progressive enlargement of the thyroid gland.

Examination at this time showed the blood pressure to be 128/84, in contrast to 184/124 on the previous admission, but the heart was still slightly enlarged on the left. Both lobes of the thyroid were about the size of a baseball and showed a few firm and several cystic areas.

Laboratory data and basal metabolic rate were within normal range.

Nine days after admission the patient was given general anesthesia and a subtotal thyroidectomy was done, leaving a very small piece of each lobe measuring about 2 cm. in greatest dimension.

The postoperative course was uneventful and the patient was discharged on the fifteenth day.

The pathologic report was colloid goiter, nodular, nontoxic in type.

A follow-up one year later showed the scars to be well healed and the thyroid gland was not palpable, but the patient complained of a voice difficulty in that she couldn't "holler." However, laryngoscopic examination revealed good motility of vocal cords.

REFERENCES

1. Wolfson, W. L.: Foreign Body in Thyroid, J. A. M. A. **87**: 1645-1646, 1926.
2. Matsuura, S., and Uetsuka, M.: 2 Fälle von Fremdkörpern im Halse (in der äusseren Wand des Oesophagus and in der Schiddrüse), Oto-rhino-laryng. **11**: 1114, 1938.
3. Takahara, T., and Watanabe, D.: Ein Obducktionsfall van malignöser Struma mit enorm grosser Zyste und Nekrotischem Herde, Oto-rhino-laryng. **12**: 307, 1939.
4. Norman, G. F.: Foreign Body in Thyroid Gland, West. J. Surg. **47**: 634-638, 1939.
5. Wullstein, H.: Frische Fremdkörperverletzung der Speiseröhre bei zugleich altem in die Schilddrüse eingeheiltem Fremdkörper. Diagnostische Irreführung. Ursächlicher Zusammenhang, Monatschr. f. Ohrenh. **75**: 82-86, 1941.

Recent Advances in Surgery

CONDUCTED BY ALFRED BLALOCK, M.D.

A DISCUSSION OF THE ACUTE CONDITIONS ARISING IN PATIENTS WITH LYMPHOGRANULOMA VENEREUM

WILLIAM P. LONGMIRE, JR., M.D., BALTIMORE, MD.

(From the Department of Surgery, Johns Hopkins School of Medicine and Hospital)

IN RECENT years the problems associated with lymphogranuloma venereum have received more and more attention, for while effective chemotherapeutic agents have been discovered and developed for other venereal diseases, little advance has been made in the successful treatment of any stage of this disease. Although lymphogranuloma venereum has been reported in every section of the United States, it is most prevalent along the coast and in the Southern States,[1] and an even greater incidence is found in tropical and subtropical countries. The infection has been reported as fairly frequent in the prewar navies of several countries. With the global distribution of our armed forces an increased incidence of this disease may be expected.

Lymphogranuloma venereum has emerged from a mass of complex clinical observations as a definite disease entity. An understanding of the true identity and clinical picture of the disease has been hampered by three main factors: (1) the difficulty of isolating and identifying the responsible infectious agent; (2) its frequent simultaneous occurrence with other venereal diseases, mainly syphilis, chancroid, and granuloma inguinale; and (3) the similarity of certain of the lesions of lymphogranuloma venereum to the lesions of these diseases.

In 1930, Hellerstrom and Wassen,[2] by extensive experimental work in both animals and man, first succeeded in definitely linking the disease with a filtrable virus. The Frei test or other similar tests since devised have been very useful in identifying the clinical pathologic conditions of lymphogranuloma venereum and isolating it from other concurrent or closely allied diseases. The frequent occurrence of hyperproteinemia with an actual and relative increase of the globulin fraction in the acute and chronic forms has also been a diagnostic aid.[3] Finally, clinical experience has demonstrated, over a period of years, certain pathologic conditions which are undoubtedly lymphogranuloma venereum although the laboratory tests are not always confirmatory. As D'Aunoy and von Haam[1] state, the diagnosis of this disease is at present

made from a combined consideration of the clinical condition, laboratory tests, and pathologic picture.

The original lesion is most often a small, transitory, frequently unnoticed ulcer occurring on or about the genitals or the rectum. This may be followed by regional adenitis occurring at any time from a few days to several months after the initial infection. The spread of the infection into the lymphatics frequently is accompanied by constitutional symptoms, such as fever, malaise, anorexia, headache, loss of weight, and pains in the joints and muscles, which persist for two to four weeks. It is now generally conceded that systemic spread of the infection may occur in certain cases. Von Haam and D'Aunoy[4] were able to isolate the virus from the spinal fluid in two of eight cases during the early acute stage of the disease, thereby demonstrating that in some instances the virus may cause a systemic infection. In a more recent report, however, these authors state, "It can be assumed that in most instances the disseminated virus is soon destroyed."[1] Cases of encephalitis and primary peritonitis resulting from lymphogranuloma venereum have been reported.[5, 6] The spread of the infection to involve the wall of the rectum, particularly in the female, is well known. Beginning with acute proctitis and edema, hyperemia, and granulation of the mucosa, the condition progresses with the appearance of benign ulcerations which frequently lead to dense scarring in the wall of the rectum and subsequent stricture of the lumen. In the female these ulcerations may extend through the rectovaginal septum, causing rectovaginal fistulas, and the urethra and paraurethral tissues may become ulcerated and stricture or possibly destruction of the urethra may result. Pararectal abscesses and fistulas are frequent secondary complications.

In this communication it is proposed to review certain pertinent data concerning the 111 cases of lymphogranuloma venereum in this series and to emphasize some of the acute conditions arising in patients known to have this disease, about which little has been written. It is realized that caution must be used in ascribing many of these conditions directly to the activity of the virus of lymphogranuloma venereum when direct evidence in most instances is lacking. However, several seemingly obscure clinical conditions can be clarified if considered as directly related to an existing lymphogranuloma venereum infection. Other conditions here discussed are generally accepted as arising from the activity of the virus but are included in this study to emphasize their frequency and severity.

MATERIAL

The material for this report has been obtained from the case histories of 111 patients admitted to the ward and private services of the Johns Hopkins Hospital and diagnosed as having lymphogranuloma venereum.

The evidence for the existence of such an infection has been reviewed for each patient and the case accepted or rejected after a consideration of the clinical observations, the Frei test or similar test when reported, the plasma protein concentration, the albumin-globulin ratio, and the pathologic studies.

FREI TEST

The Frei test has been stated to be positive after the development of buboes in 95 per cent of patients infected with the virus of lymphogranuloma venereum.[7] In this series of cases the Frei test was performed on 81 patients. In 74 it was positive, in 1 it was doubtful, and in 6 it was negative. Thirty patients on whom the Frei test was not made are included since there was adequate evidence to substantiate the diagnosis in spite of the absence of the test. All of the patients with a negative Frei test showed clinical evidence of lymphogranuloma venereum. In 1 patient on whom Paulson's test was made, the reaction was positive. Four other patients had elevation of plasma protein and reversed albumin-globulin ratio.

In the 30 patients who were not given the Frei test the diagnosis was made on clinical evidence alone in 24. Four had clinical evidence of lymphogranuloma venereum and pathologic specimens (biopsies, and so on) compatible with lymphogranuloma venereum.

TIME RELATIONSHIPS OF VARIOUS STAGES OF THE DISEASE

As most of the patients included in the present study were seen with late manifestations of the disease, exact data concerning the initial lesion and the early course are frequently lacking.

From the cases in which definite time relationships of the various stages of the disease were recorded there are reported here the interval between the appearance of buboes and the onset of other signs and symptoms. The subsequent development of the disease process has been related to the appearance of buboes rather than to the initial genital infection because the primary lesion is more apt to be unobserved, or may easily be confused with the early lesions of syphilis, chancroid, or granuloma inguinale.

In fifteen cases a "dark field negative" genital lesion was present at the time when there was acute adenitis. In seven other cases the genital lesion occurred from two days to six months prior to the onset of the active infection of the inguinal glands.

Six patients had systemic symptoms of the disease concurrently with active buboes. In 2 patients these came on two weeks after the appearance of buboes. One patient had severe systemic symptoms with the second attack of adenitis. In another patient the generalized symptoms occurred three weeks after the initial lesion but five months before the appearance of buboes.

Pararectal abscesses or fistulas in ano occurred in 14 patients five months to twenty-one years (average eight years) after the appearance of buboes. Rectal ulcerations developed in 5 patients two years to sixteen years (average five and one-half years) after the appearance of buboes. Symptoms of rectal involvement followed buboes in 16 patients in four months to fifteen years with an average interval of three years. Rectal strictures were first seen in 18 patients ten months to sixteen years (average five and one-half years) after the appearance of buboes. In 5 patients in whom a colostomy was necessary the time interval from the development of buboes to the performance of the colostomy varied from four years to fifteen years with an average interval of eight years.

SEVERE CONSTITUTIONAL REACTIONS TO EARLY INFECTION

It is well known that coincident with the spread of the infection from the primary site to involve the regional lymph nodes, systemic reactions may occur. Because of the transitory nature of the primary lesion its presence may be unnoticed by both patient and physician. The systemic effects not infrequently become manifest before there is clinical evidence of infection of the regional lymph nodes. The constitutional symptoms are at times so severe that a difficult immediate diagnostic problem is presented. Eight such cases were observed in this series.

In each of these cases the patient was acutely ill, with fever, malaise, anorexia, and headache. Three patients had a temperature of 104° F. or higher. During the initial stages of the illness the inguinal glands were either not inflamed, or were so slightly inflamed that they were not considered the source of the severe systemic reaction. Two of these patients had been seen originally in the outpatient department with the typical inguinal adenitis of lymphogranuloma venereum. Sulfanilamide (0.3 Gm. six times daily) was given until the adenitis subsided. In both of these cases the patient was admitted to the hospital with systemic symptoms, including jaundice. One was admitted ten days, the other one month, after the sulfanilamide had been discontinued. In the second case there was also recurrence of the bilateral inguinal adenitis.

SPONTANEOUS HEMORRHAGE

Slight persistent rectal bleeding is one of the commonest symptoms of lymphogranuloma venereum of the rectum and is the most important factor responsible for the frequent severe anemia seen in these patients.

In 24 patients without rectal involvement, the average hemoglobin value was 93.5 per cent, only slightly below normal. The 59 patients with rectal lesions but without a history of severe rectal bleeding showed a pronounced fall in the average hemoglobin value to 85.2 per cent.

The average value for 12 patients with severe rectal bleeding was slightly lower, 70.6 per cent. Four patients with rectal lesions and external granulomatous lesions had the lowest average hemoglobin value, 61.0 per cent. These values indicate that the anemia of these patients is probably largely due to chronic loss of blood in small amounts, frequently unnoticed by the patient. The severest anemia is seen in those patients with an added chronic external lesion that is pyogenically infected.

Fifty-nine patients in this series gave a history of rectal bleeding. In 30 the passage of blood per rectum was the first symptom of rectal involvement. Usually the blood was bright red and was passed in small amounts with the stool. Ten patients in this group were found to have an accurate early history of the disease process, and in these 10 the interval from the appearance of buboes until the onset of rectal bleeding varied from two and one-half months to fifteen years, with an average of four and two-tenths years.

In addition to slight persistent rectal bleeding, 12 patients were treated for severe spontaneous hemorrhage from the bowel. Most of these hemorrhages occurred outside of the hospital before the patients were seen, and the estimation of the amount of blood lost is undoubtedly inaccurate. It is stated as ranging from a cupful to two quarts. However, the general condition of the patient and the signs of active bleeding in all of these instances warranted hospital admission. One patient in whom bleeding persisted after admission to the hospital passed 500 c.c. of fresh blood and clots per rectum at one time. These patients were treated with bed rest and sedation. If the bleeding persisted, rectal irrigations with 10 per cent tannic acid were given. In 1 patient with persistent severe rectal bleeding after a colostomy had been performed the rectum and involved sigmoid were removed at operation, a combined abdominoperineal resection being performed. One other patient who had a rectal stricture, persistent moderate rectal bleeding, and an early malignant change in the edge of an ulcerated area at the anus was operated upon with the intention of performing an abdominoperineal resection of the rectum and sigmoid. The rectum was found imbedded in dense scar tissue on all sides and so firmly adherent to the sacrum as well as the pelvic organs that the original operation was abandoned and a presigmoidostomy performed followed by local excision of the malignant area and the lower rectum. A third patient in this group who had had two hospital admissions for severe hemorrhage from the diseased bowel, the last after the establishment of a colostomy, was recently advised to undergo the Miles operation but refused.

INTESTINAL OBSTRUCTION

Twenty-three patients in the present study were seen on one or more occasions with signs and symptoms of either partial or complete intestinal obstruction. These patients may be divided into four groups

according to the clinical course of the obstruction: (1) The first group consists of those patients seen regularly in the outpatient department with a rectal stricture and early signs of partial obstruction which grow more severe as the stenosis of the rectum progresses. They have been treated by rectal dilatations and other therapy in vogue at the time (tartar emetic, diathermy, sulfonamides, and Frei antigen). Seven such cases have progressed to such a point that a colostomy was performed to avert an acute intestinal obstruction.

(2) The second group includes those patients who had acute obstruction and typical signs of mechanical ileus. The 9 patients in this group had no acute rectal symptoms, but were found to have a dense, scarred rectal stricture with stenosis so severe as to produce complete or partial obstruction. In only 1 of these was the obstruction so severe and persistent that a colostomy was necessary for relief. Ileostomy was performed on 1 patient in whom there was partial obstruction in the transverse colon. This was done, however, not only to relieve the obstruction but also to divert the fecal stream from the lesion and thereby promote healing. Three of these patients received rectal dilatations under anesthesia, with improvement.

Five of these patients were treated with repeated enemas and bed rest, were given nothing by mouth, and had rectal dilatations without anesthesia. Two patients improved and have received subsequent dilatations in the outpatient department with adequate results. Two other patients improved temporarily; colostomy was necessary in 1 patient about one year later, and the other has had two dilatations under anesthesia. In one case the rectum was perforated and the patient died in a state of shock five and one-half hours later. This case is discussed more fully in a subsequent section.

(3) Five patients presented the classical signs and symptoms of mechanical obstruction in association with exacerbation of the inflammatory process in the rectum and lower bowel. In addition to obstipation, nausea, vomiting, distension, and hyperactive peristalsis, there were also elevation of temperature, in most cases about 102° F., leucocytosis, frequent small rectal discharges composed mainly of bloody purulent material, and extreme tenderness about the rectum and anus. In most of these patients there was also moderate tenderness in the lower abdomen. At times the tenderness has been such a prominent feature of the clinical picture that an acute surgical condition of the abdomen has been suspected.

In one instance a tangential transverse colostomy was performed immediately. When the patient was last seen eleven months after the operation the colostomy was functioning satisfactorily. The general condition was good, but she was still passing small amounts of blood and pus per rectum.

In a second case exploratory laparotomy was performed but no intra-abdominal lesion was found to account for the obstructive symptoms. The obstruction slowly yielded to duodenal suction and repeated enemas. At the time of this communication the patient has continued to have bloody stools, severe constipation, and abdominal cramps.

Two patients with this type of obstruction were treated with repeated enemas and rectal dilatations. Both had elevation of temperature and spread of abdominal tenderness following these treatments. One of these patients improved spontaneously when all rectal therapy was stopped. The other had multiple hepatic abscesses and generalized peritonitis, and died.

The last case was managed according to our present method of treatment. A Miller-Abbott tube was passed into the duodenum and constant suction was maintained. Nothing was given by mouth, and all rectal treatments were postponed until the fever, leucocytosis, and abdominal tenderness should subside. Adequate fluids were given intravenously. The signs of obstruction slowly subsided. The patient was last seen three months later at which time her bowels were moving regularly with the aid of laxatives.

(4) The fourth group is composed of two patients who had acute obstruction at or near the termination of pregnancy.

CASE 48.—A 36-year-old Negro woman was first known to have a rectal stricture, a rectovaginal fistula, and edema of the vulva in June, 1936, after which she received a series of rectal dilatations. She had managed to keep her bowels open by taking frequent laxatives until near the termination of her first pregnancy in January, 1938, when signs of complete obstruction appeared. Cesarean section and tangential colostomy in the descending colon were performed January 4. Mother and child both responded satisfactorily. She was last seen Dec. 9, 1941, and at that time there were signs of involvement of the colostomy due to lymphogranuloma venereum. She was admitted to another hospital for a higher colostomy.

CASE 50.—A 27-year-old Negro female was first known to have a rectal stricture in November, 1924. She had received irregular dilatations with satisfactory results up until the termination of her first pregnancy in January, 1928. She was first seen when in labor at another hospital and a craniotomy on the fetus was performed. Two days later there was complete obstruction and a tangential sigmoidostomy was carried out. Later she was treated with regular rectal dilatations, and the sigmoidostomy closed spontaneously. This patient died of pneumonia in October, 1930. Her bowel movements had been kept regular by occasional rectal dilatations.

In these two instances the trauma to the diseased bowel wall undoubtedly caused additional edema and swelling which blocked completely an already narrowed rectal canal. In the first case the disease process was active and continued to progress in spite of the sigmoidostomy, eventually involving and constricting the artificial outlet itself. In the second case the original stenosis was less severe, and after the acute episode, dilatations opened the rectal canal sufficiently for fairly normal passages to be resumed.

At present it is our practice to treat the patients with obstruction by conservative means. We rely mainly on duodenal suction and, in the case of patients without signs of acute rectal inflammation, on the cautious use of enemas and rectal dilatations. If there are signs of acute inflammation of the rectal canal, such as fever, pronounced rectal tenderness, frequent bloody purulent rectal discharges, or lower abdominal tenderness, we wish to stress the fact that all forms of possible rectal trauma such as enemas or dilatations should be avoided. This point will be discussed more fully in a later paragraph under the heading of Reactions to Trauma to Infected Tissue. If conservative treatment fails, a suitable colostomy or ileostomy is performed.

ARTIFICIAL FECAL OUTLET

An artificial fecal outlet was established in 20 of our patients both to relieve various degrees of obstruction and to divert the fecal stream from the diseased bowel. All but three of these enterostomies have been of the tangential or spur type, performed in the hope that subsequent improvement of the diseased bowel would permit closure. A review of our results, however, shows that this method has proved inadequate. Only 1 patient improved enough so that closure could be tolerated (Case 50, which has been discussed in the preceding section). In only one other instance has an attempt been made to close the enterostomy. This patient (Case 105) had been subjected to an exploratory operation, April 21, 1936. At that time an ulcerated lesion was found in the transverse colon which was thought to be tuberculous in origin, and a tangential ileostomy was performed. One year later the ileostomy was closed at operation. On the third postoperative day the ulcerated area in the transverse colon perforated and fatal generalized peritonitis developed. Autopsy showed extensive lymphogranuloma venereum of the entire distal half of the colon. Subsequent examination of these 20 patients showed that only 3 others had prolonged improvement. On the other hand, in 9 patients the distressing rectal symptoms persisted, and in 6 the colostomy became involved in a spread of the disease process along the bowel.

In those instances in which enterostomy was performed there have been five deaths in the immediate postoperative period. None of the deaths was directly related to the operative procedure.

When an enterostomy is necessary it should be made well above the diseased portion of the bowel and the terminal variety should be employed to exclude the possibility that any portion of the fecal stream might pass through the diseased bowel. The proximal and distal ends of the intestine should be placed on the abdominal wall at a distance from each other in order to lessen the chance of involvement of the proximal end should the disease spread along the wall of the bowel. The distal end of the bowel should always be left open on the abdominal wall

and not turned in as a blind end and left inside of the peritoneal cavity. We have not experienced any difficulty arising from the distal end of the bowel in cases of involvement of the colon due to lymphogranuloma venereum, but we have seen several instances of intraperitoneal infection arising from the distal blind end of bowel left inside of the peritoneal cavity in cases in which an enterostomy had been performed for a nonspecific ulcerative colitis.

If the rectal discharge and bleeding persist after a terminal colostomy has been performed, and the general condition of the patient does not improve, a combined abdominoperineal resection of the diseased rectum and distal colon should be considered. This procedure has been carried out in one case in this series (Case 98) with very satisfactory results. Extensive involvement of the perirectal and pelvic tissues with scarring and infected sinus tracts will at times make performance of the Miles operation inadvisable. Two such cases have been encountered (Cases 96 and 71).

REACTION FOLLOWING TRAUMA TO INFECTED TISSUE

In the treatment of the rectal strictures caused by lymphogranuloma venereum, manual dilatation of the stricture remains the most commonly employed method of preventing complete stenosis. Such dilatations are occasionally accompanied by rather severe reactions. Apparently in the unanesthetized patient the pain and tenderness of the lesion usually prevent manipulation which is extensive enough to cause severe reaction. With anesthesia, however, patients in this series have not infrequently reacted unfavorably. This has been true not only of dilatations, but also of other forms of manipulation, such as proctoscopic examination, biopsy, enema, and repeated digital rectal examinations, which traumatized the infected area.

The commonest reaction has been an elevation of temperature. Temperature elevations to 101° F. or higher following such trauma have occurred nine times in this series of cases. Usually the maximal temperature rise comes on in twenty-four to thirty-six hours. In the less severe reactions there are few signs or symptoms other than the fever. These patients may complain of headache and malaise, which disappear as the temperature drops to normal during the ensuing twelve to twenty-four hours. Five of these patients had a severe reaction with elevation of temperature to 103° F. or higher. They appeared acutely ill and complained of malaise, headache, anorexia, and nausea. With the severer reactions the fever persists for a longer period of time. One patient six hours after an extensive dilatation under anesthesia had a chill, then an elevation of temperature to 103° F. The elevated temperature persisted for twenty-five days. Three other patients had elevation of temperature and, in addition, signs of peritoneal irritation in the lower abdomen—pain, tenderness, and muscle rigidity. The pa-

tients in whom fever persists show evidence of perirectal infection with swollen, tender, indurated areas surrounding the rectum. Our treatment of all of these patients has been conservative. We have avoided further trauma to the infected areas, have kept the patients in bed, and have provided ample fluids and a limited diet. Sulfonamides are of value in the treatment of this type of reaction.

Traumatic perforation of the bowel occurred twice in this series of cases.

CASE 80.—A 49-year-old Negro woman was admitted to the hospital April 23, 1941. She had been treated at this hospital in June, 1925, for inguinal adenitis. For eight months prior to admission the patient had noticed increasing constipation, progressive diminution in the caliber of the stools, and frequent small bloody stools. She had not lost weight and felt well. Two inches above the anal margin a sharp, thin rectal stricture could be felt. Above this on the right lateral wall of the rectum there was a thickened, slightly indurated area about 2 cm. in diameter. The preoperative diagnosis was lymphogranuloma venereum with rectal stricture, and ulceration of the rectal mucosa. April 24, 1941, with the patient under sodium pentothal anesthesia, the proctoscope was passed for a distance of about eight inches when the resistance to the instrument suddenly gave way. The bowel had been perforated into the free peritoneal cavity. An exploratory laparotomy was performed immediately and a small perforation on the anterior surface of the sigmoid about three inches above the peritoneal reflection was closed. The bowel wall in this region appeared normal; however, a biopsy was not taken. The abdominal incision was closed with drainage. After operation the patient received 6 Gm. of sulfathiazole daily. A superficial wound infection developed; otherwise her convalescence was uneventful.

CASE 107.—A 38-year-old Negro woman was admitted to the accident room April 23, 1935, complaining of abdominal pain. She was acutely ill on admission and a detailed history was not obtained. For several years she had noted increasing constipation. Her acute illness began three days before admission with severe abdominal cramps, nausea, vomiting, and obstipation. She had taken three enemas on the day of admission but had expelled none of the fluid. Another enema was given on admission to the accident room and this also was retained. On physical examination the temperature was 98.4° F., pulse 100, respirations 28. She was breathing with difficulty and preferred a sitting posture. The abdomen was greatly distended but was not rigid or tender. A small amount of watery brown stool trickled from the rectum. The distal 5 cm. of the rectal mucosa were normal, but above this point there was a firm stricture which admitted the tip of the index finger. The opening of the stricture was gently dilated, but the stenosis extended for some distance above the opening and this portion of the bowel was unyielding. Following this examination the discharge of stool increased and the patient felt somewhat relieved. A second enema was given but could not be expelled. Both enemas were given with a soft rubber tube. A few minutes after the second enema the patient complained of weakness and severe abdominal pain, and the pulse became rapid and weak. Respirations were rapid and the extremities were cold. The abdomen became diffusely tender and rigid. Intravenous fluids and stimulants were given, but the patient died five and one-half hours later.

At autopsy a rectal stricture 6 cm. long was found starting 3 cm. above the anus. The wall of the stricture was thickened and hard. The mucosa was ulcerated. Three centimeters above the beginning of the stricture there was a fresh longitudinal tear 2 cm. in length which opened directly into the peritoneal cul-de-sac. The peritoneal cavity contained over a liter of soapy liquid feces and gas.

In both of these cases the obstruction to the rectal canal had apparently caused undue force to be used in these procedures and the bowel wall had been perforated.

Secondary hemorrhage is another complication which may occur following any operative or manipulative procedure on tissue infected with the virus of lymphogranuloma venereum. Six patients in this series have had moderate or severe bleeding following such procedures. Three patients bled from the rectum following a rectal dilatation without anesthesia; in all instances the bleeding was severe enough to warrant hospital admission. A fourth patient bled continuously for twenty-four hours following dilatation under anesthesia. In all four of these instances the bleeding stopped spontaneously. The patients were treated with bed rest, sedation, and limited diet, and further trauma to the rectum was avoided. The fifth patient lost an estimated 200 c.c. of blood from the operative area six hours after hemorrhoidectomy. The bleeding was controlled by packing the rectal canal with gauze. The remaining patient bled moderately for three days following the repair of a third degree perineal tear. The bleeding stopped spontaneously.

In performing any type of operative procedure upon these patients it is important to bear in mind the tendency of the infected tissue to bleed. In the excision of hemorrhoids or fissures and fistulas about the rectum all bleeding points should be carefully ligated or cauterized. The small blood vessels in this scarred and infected tissue fail to contract and thrombose spontaneously as they do in normal tissue.

Certain patients have had repeated reactions to different types of trauma. One patient had an elevation of temperature above 102° F. following hemorrhoidectomy, after rectal dilatation one year later, and following two subsequent pregnancies. Other patients have reacted unfavorably only during periods when there was an acute inflammatory condition elsewhere in the body, such as acute arthritis, or an active infection of the eye.

CASE 61.—A 19-year-old Negro female was first known to have a rectal stricture in January, 1928, when she received three rectal dilatations without anesthesia and had no unfavorable reaction. The rectal symptoms improved and she was not seen again until March, 1939. At that time the patient had a dense rectal stricture, and she received regular rectal dilatations every six weeks to two months for the next three years. One dilatation was performed under anesthesia. None of these treatments caused any unfavorable reaction. Feb. 17, 1942, the patient was admitted with a tender, hot swelling of the left knee joint. She also complained of malaise, headache, and anorexia; temperature was 101° F. The general physical examination was negative with the exception of the affected knee and the dense rectal stricture. The origin of the acute arthritis of the knee was not determined. A gonorrheal infection was suspected but proof was lacking. March 6, while the knee was still acutely inflamed, the rectal stricture was dilated with the patient anesthetized. Twenty-four hours later her temperature rose to 103° F., and she became acutely ill. She complained of malaise, nausea, and headache. The temperature dropped to normal in about thirty-six hour and all of her symptoms cleared spontaneously.

PREGNANCY OCCURRING IN PATIENTS WITH LYMPHOGRANULOMA VENEREUM*

In this series of cases there have been 28 patients who have undergone a total of 43 term pregnancies during an infection with lymphogranuloma venereum. There were four premature infants. Two of these died during the first week of life. Twins occurred once; one child was normal, the other was a fetus papyraceus. There was only one fetal death (Case 50) that might be attributed directly to the presence of lymphogranuloma venereum. Craniotomy on the fetus had been performed during this delivery at another hospital for dystocia due to perirectal scarring, induration, and a contracted pelvis. Thirty-five, or 79.5 per cent, of the infants were discharged from the hospital well. Four stillborn infants were delivered from 3 mothers. Two of the mothers had untreated syphilis and the third inadequately treated syphilis. One unexplained infant death occurred on the eighth day. The mother of this child had untreated syphilis, with one macerated fetus born before and another after this pregnancy.

Following twelve deliveries (27.9 per cent) there was a significant elevation of temperature; seven of these were mild, the so-called "one-day fever." Three patients had fever of low grade ranging from 100 to 102° F. which persisted for a week or more. In one patient the temperature remained elevated for five weeks. Nothing could be found on physical examination of these patients to account for the hyperpyrexia, and the patients were all asymptomatic. It is possible that these elevations of temperature can be explained as a result of the trauma associated with the passage of the fetus over the infected rectal tissue, a reaction similar to that frequently seen following rectal dilatations.

In 2 of the patients there was persistent fever with signs of spread of the infection from the rectum into the surrounding tissue.

CASE 40.—A 31-year-old Negro woman who was first known to have a rectal stricture in October, 1920, had a normal spontaneous delivery, March 20, 1924. For the first seven days she was asymptomatic but had an elevation of temperature ranging between 100 and 101° F. On the eighth post-partum day the temperature rose to 104° F. and the patient complained of pain about the vulva and perineum. On examination this region was found to be tender, swollen, and indurated. The temperature slowly fell to normal during the ensuing two weeks as the signs of inflammation in the perineum cleared.

CASE 45.—A 26-year-old Negro female was first seen when she had been in labor for twenty-six hours. Her general condition was good although the temperature was 102° F. The cervix was fully dilated and the right arm presented. She had a spontaneous delivery, and her immediate post-partum course was satisfactory. She was admitted on the tenth day after delivery with temperature of 103.4° F., generalized abdominal tenderness, and urinary retention. She complained of severe abdominal cramps and diarrhea. A tender indurated mass was felt in the tissues surrounding the right side of the rectum, and there was a firm rectal stricture. The temperature subsided as the perirectal mass slowly disappeared.

*Most of the cases included in this section have been reviewed by Kaiser.[5]

It is interesting that in both of these cases the signs and symptoms developed relatively late. In the one instance the inflammatory area appeared on the eighth post-partum day and in the other on the tenth post-partum day. This type of reaction with spread of the infection into the surrounding tissues has also been seen following other types of trauma to the diseased rectum as described in the preceding section.

Eight cesarean sections were performed in this series, 6 mothers being thus delivered. All of these operations resulted in living children. The indications for cesarean section in these cases were as follows: exacerbation of the rectal process with acute intestinal obstruction (cesarean section and colostomy, 1 patient); rachitic pelvis with contraction (2 patients with two pregnancies each); extensive rectal involvement with pararectal abscesses and fistulas (2 patients); history of dystocia and previous craniotomy (1 patient).

There were no maternal deaths following cesarean section. In 3 of these patients a postoperative wound infection developed. One patient had an unexplained prolonged elevation of temperature. In 1 patient a postoperative pelvic thrombophlebitis developed. There was one post-partum hemorrhage.

The only maternal fatality in the series occurred in a case seen on the outpatient obstetric service which was unattended. The patient was in profound shock when first seen and died before any form of treatment could be given. At autopsy a ruptured uterus was found. The only sign of lymphogranuloma venereum in this patient was a rectal stricture which seemed entirely unrelated to the uterine rupture.

At the present time it is the opinion of our obstetric staff that lymphogranuloma venereum of the rectum, per se, is not necessarily a contraindication to a normal vaginal delivery. The patients are followed carefully throughout their antepartum course, and each case is evaluated individually.

As stated by Kaiser,[8] "Involvement of the pouch of Douglas by the pelvic scarring, regardless of the caliber of the stricture or the state of the rectovaginal septum, is felt to carry with it the greatest risk of rupture of the rectum, and cesarean section is advised. Scarring of the rectovaginal septum and the presence of rectovaginal fistula appear less grave, and the decision in regard to cesarean section depends on parity, the state of the pelvis, the history of previous bowel obstruction, and other potential causes of dystocia. Stricture of the rectal wall in which all scarring is limited to the rectal wall and especially where the stricture is high and out of the pelvis, is not thought to be a bar to pelvic delivery."

As Wilson and Hesseltine[9] have stated, we find no indication that pregnancy alters the course of the disease. The mechanical effects of the enlarged uterus and the passage of the fetus through the birth canal are responsible for certain secondary complications. The 2 patients

in whom acute intestinal obstruction developed at term illustrate this point. If a cesarean section is necessary, the patient should be sterilized.

INTRA-ABDOMINAL CONDITIONS

Nine patients in this series were admitted with signs and symptoms of an acute intra-abdominal lesion. It is interesting that although subsequent operation on 4 of these patients disclosed various pathologic conditions in the abdomen, the signs and symptoms of 7 of them were similar. These 7 patients complained of pain in the right upper quadrant of the abdomen, and there were varying degrees of tenderness and muscle spasm in this region.

Three of the 7 patients did not seem acutely ill. The temperature and white cell count were within normal range and the signs of peritoneal irritation were moderate. Cholecystitis or hepatitis was considered in each case. Roentgenograms of the gall bladder were normal, and the patients improved while under observation. The other 4 patients, however, were acutely ill. They complained of severe epigastric and right upper quadrant pain associated with chills and fever, nausea, vomiting, malaise, and headache. Two of the patients were jaundiced. In one the abdominal signs appeared during the early course of the disease. The patient (Case 24) was admitted three weeks after the appearance of a penile lesion and one week after onset of bilateral inguinal adenitis. A similar case has been reported by Eberhard.[6] His patient had fibrinous peritonitis occurring during the presence of active buboes. The other 3 patients when admitted had well-developed rectal strictures. All had a "spiking" fever, with temperature ranging from 101 to 105° F., with a leucocyte count from 11,000 to 20,000. These 4 patients were subjected to operation. The preoperative diagnosis in each instance was influenced by the signs in the right upper quadrant of the abdomen. The diagnoses suggested before operation were as follows: acute cholecystitis, perforation of the gall bladder, or hepatic abscesses. At operation the following conditions were found: Case 101, multiple hepatic abscesses; Case 106, the peritoneum and all the intra-abdominal organs were thought to be normal although autopsy two days later disclosed a nonspecific granulomatous lesion about the cecum with enlarged mesenteric lymph nodes and an extensive tuberculous pneumonia; Case 82, the gall bladder was removed and on microscopic section showed slight chronic cholecystitis; the exploration was otherwise negative; Case 24, sterile fibrinous peritonitis.

One other patient in this group (Case 99) complained of severe abdominal cramps, right para-umbilical pain, nausea, and vomiting. She had a temperature of 101° F. on admission, with moderate tenderness and muscle spasm on the right side, most pronounced in the lower quadrant. With a tentative diagnosis of appendicitis, this patient was operated upon. A normal appendix was found. The peritoneal cavity

contained some free, cloudy fluid and there was a small amount of fibrin on the peritoneal surface. A diagnosis of tuberculous peritonitis was made but was not confirmed. Shortly after this operation the patient began to pass blood and pus per rectum. Later a rectal stricture developed and she was found to have a positive Frei test.

The last patient in this group (Case 104) had a history of buboes four and one-half years previously. Two weeks before admission he began to have generalized soreness in the right side of the abdomen. The soreness persisted until the day before admission when he began to have sharp cramps in the right lower quadrant of the abdomen. At this time he noticed a painful lump to the right of the umbilicus. On examination at the time of admission he was found to have a freely movable, tender mass in the right lower abdomen with muscle rigidity in this region. The white cell count was 12,100. At operation an inflammatory mass of the cecum was resected and an ileotransverse colostomy performed. The postoperative course was uneventful. On microscopic examination the mass showed chronic nonspecific inflammatory tissue. The patient's Frei test was positive.

The only patient in this group who benefited from operation was the one in whom a granulomatous lesion of the cecum was resected. In all of these cases operation was performed only after a period of observation during which the patients failed to improve or showed signs of becoming definitely worse. It is possible that in the future, patients with lymphogranuloma venereum and apparent acute conditions of the abdomen may be spared operation if these instances are borne in mind.

In an earlier section of this communication there have been reported a number of patients with signs of peritoneal irritation in the lower abdomen following trauma to the diseased tissue.

SPONTANEOUS PERFORATION OF THE INTESTINE

Spontaneous perforation of the diseased intestine into the free peritoneal cavity occurred three times in this series of cases. In each instance the perforation occurred within a few days after some type of operative procedure. In only one of these cases (Case 105) was the perforation definitely due to a lymphogranuloma venereum ulceration of the bowel wall. This patient had had ileostomy performed to divert the fecal stream from an ulcerated lesion in the transverse colon. At the time of operation the lesion was thought to be tuberculous. At a second operation one year later, signs of active ulceration of the transverse colon were noted; however, the ileostomy was closed. The patient died seventy hours after operation. Post-mortem examination showed perforation of one of the ulcerated areas of the transverse colon with generalized fibrinopurulent peritonitis. The entire rectum and distal colon were involved in an extensive colitis due to lymphogranuloma venereum. The Frei test had been positive.

In the other two cases secondary factors make the origin of the perforation uncertain.

CASE 97.—Ileostomy was performed on this patient for a rapidly spreading lymphogranulomatous infection of the colon. Repeated examinations by x-ray had shown progression of the disease to involve the entire colon within a period of two months. During the postoperative course there was moderate, persistent abdominal distension. On the seventeenth postoperative day the patient showed evidence of circulatory collapse and generalized peritonitis. On exploratory laparotomy an obstruction of the ileum caused by a band of adhesions was found. The proximal intestine was tremendously distended and several perforations were found in the wall of the ileum above the obstruction. A segment of ileum including the perforations was resected. The patient died on the fifth postoperative day. Microscopic sections of the perforated intestine showed numerous ulcerations of the mucosa. The wall of the intestine was infiltrated by large numbers of polymorphonuclear cells, mononuclear cells, and plasma cells. The blood vessels were greatly dilated. The pathologic picture was nonspecific, and the final diagnosis was subacute nonspecific ulcerative enteritis with perforation.

In this patient with a rapidly advancing infection it is possible that the small intestine had become affected. However, with the long-standing partial obstruction, tremendous intestinal distention, and nonspecific inflammatory reaction in the intestinal wall, no definite conclusion can be drawn as to the origin of the perforation.

CASE 102.—This patient had several mucosal ulcerations from the rectum to the splenic flexure. Ileostomy was performed, but pneumonia developed and the patient died on the ninth postoperative day. At autopsy he was found to have perforation of the ileum just below the ileostomy with localized peritonitis. Here again microscopic sections showed the ulceration about the perforation to be nonspecific, and the origin of the perforation is uncertain.

Two other patients have had perforation of the lower sigmoid, but in both the process was limited to pelvic peritonitis followed by dense pelvic adhesions. In one of the patients (Case 96, previously mentioned) several sinus tracts were demonstrated by x-ray examination to extend from the lower sigmoid into the pelvis. At the time of this communication, the patient has a terminal transverse colostomy, and to date none of these sinus tracts has opened externally. The second patient when first seen in 1926 had been treated elsewhere for six years for extensive ulcerations and stricture of the rectum. On admission here she had a fecal fistula originating in the sigmoid and opening externally through an old McBurney incision and a lower midline incision.

ACUTE ARTHRITIS

Twenty-one patients in this series have been seen one or more times with acute infectious arthritis. It is well known that pain in joints and muscles frequently occurs during the early stages of lymphogranuloma venereum; in many of these patients, however, the arthritic process appeared years after the initial infection, often with signs of exacerbation of the disease elsewhere in the body. In nine cases in which ac-

curate time intervals of the various stages of lymphogranuloma venereum could be established, the onset of the first attack of acute arthritis varied from the date of the appearance of active buboes until fourteen years later, with an average interval of five years.

Ten of the patients had recurring attacks affecting the same or different joints. The joints were red, tender, and swollen, and there was limitation of motion. Frequently the joint became fluctuant. Associated systemic symptoms were at times pronounced, and the patients complained of malaise, nausea, and headache. Elevations of temperature as high as 105° F. were recorded. After an acute attack the process usually slowly but completely subsided without permanent damage to the joint. In all 5 patients in whom there was monarticular arthritis the knee was the affected joint. The other 16 patients had polyarthritis. In these instances the knee, the ankles, and the elbow were most frequently involved.

Eleven of these patients had extensive lymphongranuloma venereum of the colon and rectum. Seven patients had a colostomy and the other 4 had been admitted with signs of intestinal obstruction. In 9 of these patients an obscure infection of the eye was treated. In none of these cases was the arthritis shown to be directly related to the existing lymphogranuloma venereum. No attempt was made, however, to isolate the virus from the inflamed joints. All routine cultures of material aspirated from the joints were sterile, complement fixation reactions for gonorrhea, when performed, were negative, and roentgenograms of the joints showed no abnormality.

Joints that were aspirated contained a clear, straw-colored, viscid fluid. The protein content of the aspirated fluid was determined in two cases. In one patient the blood serum protein was 8.35 Gm. per cent, the albumin-globulin ratio was 45:55, and the protein content of the joint fluid was 6.14 Gm. per cent with an albumin-globulin ratio of 40:60. The second patient had a blood serum protein of 6.7 Gm. per cent, albumin 3.53 Gm. per cent, and globulin 3.17 Gm. per cent. The fluid in the joint had a protein concentration of 3.96 Gm. per cent.

Five of these patients with severe polyarthritis have improved rapidly with sulfathiazole or sulfadiazine therapy. In two other cases sulfonamides have seemed to have little effect on the progress of the inflammation of the joint.

Our knowledge of this phase of the disease is limited, and lacking definite proof of the origin of the arthritis in these cases, I hesitate to emphasize unduly the following interesting relationships: (1) the frequency of acute infectious arthritis in this series of patients (18.9 per cent); (2) the frequent occurrence of arthritis in patients with an advanced infection of the colon and rectum due to lymphogranuloma venereum, and in patients with an obscure ophthalmitis; (3) the si-

multaneous exacerbation of the arthritis and of the inflammation of the bowel; (4) the systemic reactions which occur when apparently quiescent rectal strictures are dilated during an attack of acute arthritis.

INFECTIONS OF THE EYE

Oliphant, Powell, and Perrin[10] have reported a case of accidental ophthalmitis due to lymphogranuloma venereum occurring in a laboratory worker. Conjunctivitis, keratitis, and a marginal corneal ulcer developed. Sulfadiazine was given, and the patient recovered completely.

Although the occurrence of inflammatory conditions in the eyes of patients known to have lymphogranuloma venereum has been noted by various observers, it has never been definitely shown that the virus of lymphogranuloma venereum was the cause of the eye infection. An infection of the eye arising in a patient with lymphogranuloma venereum, apparently by systemic spread of the disease, is, of course, different from direct infection of the eye as in Oliphant's case.

In four instances in the present series unsuccessful attempts were made to isolate the virus from infected tissue taken from the diseased eye. However, in spite of the lack of substantial proof that these infections of the eye are due to the virus of lymphogranuloma venereum, the following suggestive facts are recorded:

Sixteen patients in this series (14.4 per cent) have been treated in this hospital for some type of infection of the eye after a diagnosis of lymphogranuloma venereum had been made. Four other patients who gave a history of an eye infection but were not treated here are not included in this discussion. In the 16 patients the following diagnoses were made:

Conjunctivitis	4	Phlyctenular keratitis	2
Episcleritis	3	Corneal ulcer	3
Scleritis	1	Acute iritis	5
Keratitis	5	Chronic kerato-iritis	1

The Frei test was positive in all of these patients but one. This patient had a "doubtful" result, but the serum protein was 9.07 Gm. per cent and the albumin-globulin ratio 44:56.

Many of these infections were similar to the inflammatory eye conditions of syphilis and tuberculosis. Eight of these patients had a negative serologic test for syphilis; 2 of the 8 gave a history of previous antisyphilitic treatment elsewhere. The other 8 patients had been found to have a positive serologic test. Three had latent syphilis and had received adequate treatment. Four had been seen in this hospital during the secondary stage with cutaneous manifestations of syphilis from three to eight years prior to onset of the infection of the eye. Three of these 4 had been adequately treated; the other had received no treatment. One other patient had received adequate treatment but a diagnosis of the stage of the disease was not given. Thus, in the

entire group of 16 patients only 2 had inadequately treated syphilis at the time of onset of the eye infection. One of these had latent syphilis and the other had had cutaneous manifestations of the secondary stage three years previously.

In 7 patients the tuberculin test was negative in a dilution of 1:1000. One patient had a positive reaction to the 1:1000 dilution but showed no signs of an active tuberculous infection elsewhere in the body.

Accurate records of the early stage of the lymphogranuloma venereum were available in 9 of these patients. Infections of the eye occurred from four and one-half months to seventeen years (average five years) after the appearance of buboes. Two of these patients gave a history of a genital lesion, one seven years and the other ten years before the infection of the eye. They had not had buboes or any other clinical signs of lymphogranuloma venereum. Both patients had a negative serologic test for syphilis. Four patients had had buboes but there were no other clinical signs of lymphogranuloma venereum. Anorectal involvement was present in 10 patients at the time of onset of the eye infection.

A specimen was taken for biopsy of the lacrimal gland and conjunctiva of 1 patient who had been diagnosed as having chronic recurrent scleritis and chronic kerato-iritis. The diagnosis of the tissue examined microscopically was chronic nonspecific inflammatory tissue.

One patient was treated with sodium sulfanilate and another with sulfathiazole. Both improved. All of the others have improved spontaneously with symptomatic treatment. Six have had recurrent attacks of infection of the eye.

SUMMARY

A review is presented of the case histories of 111 patients with lymphogranuloma venereum who have been admitted to the Johns Hopkins Hospital, with special reference to the acute conditions associated with this disease.

The Frei test was performed on 81 patients. In 74 it was positive, in one doubtful, and in 6 negative. Thirty patients did not have the test. There was adequate additional evidence in these cases to substantiate the diagnosis in spite of the absence of a Frei test or the presence of a negative result.

The interval between the initial infection and the onset of various stages of the disease has been calculated in cases where adequate information was available.

Severe constitutional reactions in early infections occurred in 8 patients, with elevations of temperature as high as 106° F.

The anemia so frequently seen in patients with lymphogranuloma venereum is due to chronic loss of blood from the rectal lesions. Rectal hemorrhage severe enough to necessitate admission to the hospital occurred in twelve instances.

Twenty-three patients were treated for partial or complete intestinal obstruction. The tangential colostomy which was performed most frequently on the 20 patients requiring an artificial fecal outlet has proved unsatisfactory. A terminal transposition colostomy is now recommended.

Traumatization of infected tissue by biopsy, dilatation, proctoscopic examination, enema, or repeated digital rectal examinations may cause unfavorable reactions with elevations of temperature as high as 105° F. Traumatic perforation of the bowel occurred twice in this series.

Twenty-eight patients had forty-three pregnancies during the course of an infection with the virus of lymphogranuloma venereum. One fetal death might be attributed to the presence of the infection. There were no maternal deaths related to the disease. Lymphogranuloma venereum of the rectum is not necessarily a contraindication to normal vaginal delivery.

There were signs and symptoms of an acute intra-abdominal lesion in 9 patients. The following lesions were found in 4 patients subjected to operation who had signs of an acute process in the right upper quadrant of the abdomen: (1) multiple hepatic abscesses; (2) a nonspecific granulomatous lesion of the cecum with enlarged mesenteric lymph nodes; (3) sterile fibrinous peritonitis; (4) negative findings with the exception of slight chronic cholecystitis. Two other patients with clinical evidence of an acute intra-abdominal lesion were operated upon. One was found to have sterile peritonitis; the other had a chronic inflammatory mass of the cecum. The second patient, who had a palpable abdominal mass before operation, was the only one in whom exploration was beneficial.

Perforation of an ulcerated area of the colon into the free peritoneal cavity occurred in one patient after a functioning ileostomy had been closed. Two other instances of perforation of an ulceration of the small intestine possibly due to lymphogranuloma venereum are described.

The frequency of the occurrence in these patients of acute arthritis and of certain inflammatory conditions of the eye is interesting regardless of the fact that there is as yet no definite evidence that such conditions are directly related to lymphogranuloma venereum.

REFERENCES

1. D'Aunoy, R., and von Haam, E.: Arch. Path. **27**: 1032, 1939.
2. Wassen, E.: (Summary of numerous published reports of experimental work of Hellerstrom and Wassen.) Acta path. et microbiol. Scandinav. Supp. 23, pp. 1-181, 1935.
3. Howard, M. E., Eiseman, A. J., and Strauss, M. J.: Am. J. Syph., Gonor. & Ven. Dis. **23**: 83, 1939.
4. von Haam, E., and D'Aunoy, R.: J. A. M. A. **106**: 1642, 1936.
5. Sabin, A. B., and Aring, C. D.: J. A. M. A. **120**: 1376, 1942.
6. Eberhard, T. P.: Ann. Surg. **107**: 380, 1938.
7. Diagnosis and Treatment of the Venereal Diseases, Circular Letter No. 18, J. A. M. A. **116**: 2405, 1941.
8. Kaiser, T. H.: Am. J. Obst. & Gynec. **46**: 672, 1943.
9. Wilson, C. L., and Hesseltine, H. C.: Am. J. Obst. & Gynec. **43**: 459, 1942.
10. Oliphant, J. W., Powell, W. F., and Perrin, T. L.: J. A. M. A. **118**: 973, 1942.

BATTLE FRONT SURGERY—Surgery by flashlight was not uncommon in the early days of the Marine occupation of Munda. Here Harry Rubenstein, Pharmacist Mate, First Class, U.S.N., of 7549 Lexington Avenue, Hollywood, Calif., holds the light while Lieutenant Leonard J. Monson (MS) U.S.N. of Canby, Minn., cleans the wound of a Marine who had a bullet pass completely through his foot. Standing by to assist are (left) Eugene J. Kottenstette, Pharmacist Mate, Second Class, U.S.N., of 3933 Georgia Street, San Diego, Calif. and Carl N. Rusch, Jr., Pharmacist Mate, First Class, of Battle Creek, Iowa. (Official U. S. Marine Corps photo.)

ANNOUNCEMENT

The Samuel D. Gross Prize

The Philadelphia Academy of Surgery announces that essays will be received until Jan. 1, 1945 in competition for The Samuel D. Gross Prize of $1,500. The conditions annexed by the testator are that the prize "shall be awarded every five years to the writer of the best original essay, not exceeding 150 printed pages, octavo, in length, illustrative of some subject in Surgical Pathology or Surgical Practice founded upon original investigations, the candidates for the prize to be American citizens."

It is expressly stipulated that the competitor who receives the prize shall publish his essay in book form, and that he shall deposit one copy of the work in the Samuel D. Gross Library of the Philadelphia Academy of Surgery, and that on the title page it shall be stated that to the essay was awarded the Samuel D. Gross Prize of the Philadelphia Academy of Surgery.

The essays, which must be written by a single author in the English language, should be sent to the "Trustees of the Samuel D. Gross Prize of the Philadelphia Academy of Surgery, care of the College of Physicians, 19 South 22nd Street, Philadelphia," on or before Jan. 1, 1945.

Each essay must be typewritten, distinguished by a motto, and accompanied by a sealed envelope bearing the same motto, containing the name and address of the writer. No envelope will be opened except that which accompanies the successful essay.

The Committee will return the unsuccessful essays if reclaimed by their respective writers, or their agents, within one year.

The Committee reserves the right to make no award if the essays submitted are not considered worthy of the prize.

CHAS. F. MITCHELL, M.D.
CALVIN M. SMYTH, M.D.
DAMON B. PFEIFFER, M.D.
Trustees.

Book Reviews

Air-Borne Infection, Some Observations on Its Decline. By Dwight O'Hara, M.D., Professor of Preventive Medicine, Tufts College Medical School, Boston, Mass. Pp. 114, illustrations 14. New York, 1943, Commonwealth Fund. $1.50.

The point of view of preventive medicine has become in recent years one which extends not only to the limits of medicine and surgery but is inseparable from the practical application of both. In his book, O'Hara presents specifically the preventive point of view toward air-borne infections, together with an attempt to discover the true relations of cause and effect between man and his respiratory flora.

One of the problems faced by preventive medicine is the appreciation of diseases such as smallpox and diphtheria, which have practically ceased to appear, and the ability to recognize them on the rare occasions when they do.

In *Air-Borne Infection* attention is called by means of very graphic charts to the steady decline in the mortality of air-borne infections over the last forty years. Air transfer of disease is still an unsolved problem, and it is re-emphasized by the author that the reservoir is not the polluted air but the mucous membranes. Artificially conditioned air is as good a vehicle between throats as polluted air. "Anything which interferes with the normal mechanisms of the respiratory passages invites the invasion thereof." Air-borne diseases have their greatest power of attack in combinations, a strategy used by the measles virus and streptococci; diphtheria bacilli and streptococci; influenza virus and Pfeiffer's bacilli, streptococci, or staphylococci; the virus of the common cold and pneumococci. Of these, the combination of a virus and a bacterium seems to be especially effective, according to O'Hara. The morbidity rates of influenza and pneumonia parallel each other, with pneumonia following closely behind. O'Hara states, "Today it is generally agreed that most if not all cases of so-called 'lobar pneumonia' are clinical examples of this sequential or combination attack by the virus of the common cold and the pneumococcus."

The septic and toxic methods of attack by the streptococcus are outlined in graphic form to illustrate the various types of clinical infection. Attention is directed to the early recognition of glomerular nephritis and rheumatic fever, and the preventive opportunities which lie in the thorough examination of apparently trivial disorders. The author points out that the early recognition and isolation of the tuberculous patient has been in large part responsible for the decline in this disease, but with a word of caution that within a few generations the herd immunity to the disease will also disappear.

The natural amelioration of air-borne diseases accounts in large measure for their decline. Improved medical management, modern nursing, and public health activities representative of a better general standard of living have all played roles in this improvement. O'Hara believes that today our respiratory health is at its all-time high. The chances of a repetition of such a visitation as that of 1918 are slight, he affirms, and if there should be such a recurrence, chemotherapy of today could lessen its virulent complications.

The book was written from the public health point of view, and covers the history of air-borne infection and its decline admirably. It is somewhat regrettable

that the author neglected to discuss the use of ultraviolet light and aerosols in the prevention of air-borne disease, particularly with regard to their use in nurseries, operating rooms, and closed spaces such as the living quarters of many of the personnel of our Armed Forces.

Diagnosis of Uterine Cancer by the Vaginal Smear. By George N. Papanicolaou, M.D., and Herbert F. Traut, M.D. New York, 1943, Commonwealth Fund.

This monograph, based on vaginal smears from 3,014 adult women, obviously represents a vast amount of labor in collecting, examining, and classifying the material studied. The work is beautifully and copiously illustrated by eleven colored plates, depicting the appearances of cells found normally and in carcinoma of the uterus and cervix. That this is a simple and easy method of diagnosis of uterine and cervical carcinoma is not apparent. It would appear that prolonged and intense study of vaginal smears would be necessary before one became really competent to identify the many individual types of cells which may be present. To distinguish readily the various malignant from the nonmalignant cells would seem to require training comparable to that necessary for a hematologist. This is surely not a method of diagnosis wherein one could become expert in a short time. In the hands of the authors it was reliable in better than 90 per cent. However, the authors state, "We still adhere to the position that the vaginal smear should usually be considered as an accessory or preliminary method of diagnosis, and that the actual demonstration of the malignant cells in the biopsy specimen should be the basis of decision as to the method of therapy."

The authors are to be congratulated on a valuable piece of work, which has been conscientiously and well done.

Books Received

The receipt of books is acknowledged in this section and this treatment must be regarded as sufficient acknowledgement of the courtesy of the senders. Selections will be made for more extensive review dictated by the interests of our readers and as space permits.

UROLOGY IN GENERAL PRACTICE. By Nels F. Ockerblad, M.D., and Hjalmar E. Carlson, M.D. Cloth. Pp. 383, with 97 illustrations. Chicago, 1943, The Year Book Publishers, Inc.

SURGICAL ERRORS AND SAFEGUARDS. By Max Thorek, M.D., Professor of Surgery, Cook County Hospital, Chicago. Cloth. Price $15.00. Pp. 1085, with 794 illustrations. Philadelphia, 1943, J. B. Lippincott Company.

PAIN: RESEARCH PUBLICATIONS OF THE ASSOCIATION FOR RESEARCH IN NERVOUS AND MENTAL DISEASE. Prepared by the Editorial Board: Harold G. Wolff, M.D., Chairman; Herbert S. Gasser, M.D., and Joseph C. Hinsey, Ph.D. Cloth. Price $7.50. Pp. 468, with 116 illustrations, and 19 tables. Baltimore, 1943, Williams & Wilkins Company.

BACKACHE AND SCIATIC NEURITIS. By Philip Lewin, M.D., F.A.C.S., Northwestern University Medical School, Cook County Hospital, Chicago. Cloth. Pp. 745, with 235 illustrations. Philadelphia, 1943, Lea & Febiger.

THE HOSPITAL IN MODERN SOCIETY. By Arthur C. Backmeyer, M.D., University of Chicago Clinics, and Gerhard Hartman, Ph.D., Newton Hospital, Newton Lower Falls, Mass. Cloth. Price $5.00. Pp. 768, no illustrations. New York, 1943, Commonwealth Fund.

SURGICAL CLINICS OF NORTH AMERICA, WAR SURGERY. Many contributors. Cloth. Pp. 1763, with 520 illustrations. Philadelphia, 1943, W. B. Saunders Company.

YEAR BOOK OF INDUSTRIAL AND ORTHOPEDIC SURGERY. Edited by Charles F. Painter. Cloth. Price $3.00. Pp. 500, with 274 illustrations. Chicago, 1943, The Year Book Publishers, Inc.

MINOR SURGERY. By Frederick Christopher, S.B., M.D., F.A.C.S., Associate Professor of Surgery, Northwestern University, Chicago; Chief Surgeon, Evanston Hospital. Cloth. Price $10.00. Pp. 1006, with 575 illustrations. Philadelphia, 1944, W. B. Saunders Company.

AIR-BORNE INFECTION: SOME OBSERVATIONS. By Dwight O'Hara, M.D., Professor of Preventive Medicine, Tufts College Medical School. Cloth. Price $1.50. Pp. 114, with 14 illustrations. New York, 1943, Commonwealth Fund.

TRAUMATIC INJURIES OF FACIAL BONES; AN ATLAS OF TREATMENT. By John B. Erich, D.D.S., M.D., Consultant in Laryngology, Oral and Plastic Surgery, Mayo Clinic, and Louie T. Austin, D.D.S., F.A.C.S., Head of Department of Dental Surgery, Mayo Clinic. Cloth. Price $6.00. Pp. 600, with 353 illustrations. Philadelphia, 1944, W. B. Saunders Company.

ARTHROPATHIES—A HANDBOOK OF ROENTGEN DIAGNOSIS. By Alfred A. de Lorimer, A.B., M.A., M.D. Cloth. Price $5.50. Pp. 319, with 678 illustrations. Chicago, 1943, The Year Book Publishers, Inc.

SURGICAL CLINICS OF NORTH AMERICA, ABDOMINAL SURGERY. Many contributors. Cloth. Pp. 250, with 58 illustrations. Philadelphia, 1944, W. B. Saunders Company.

OFFICE ENDOCRINOLOGY. By Robert B. Greenblatt, B.A., M.D., C.M., Professor of Experimental Medicine, University of Georgia School of Medicine; Director of Sex Endocrine Clinic, University Hospital, Augusta, Ga. Cloth. Price $4.00. Pp. 243, with 48 illustrations. Springfield, Ill., 1944, Charles C Thomas, Publisher.

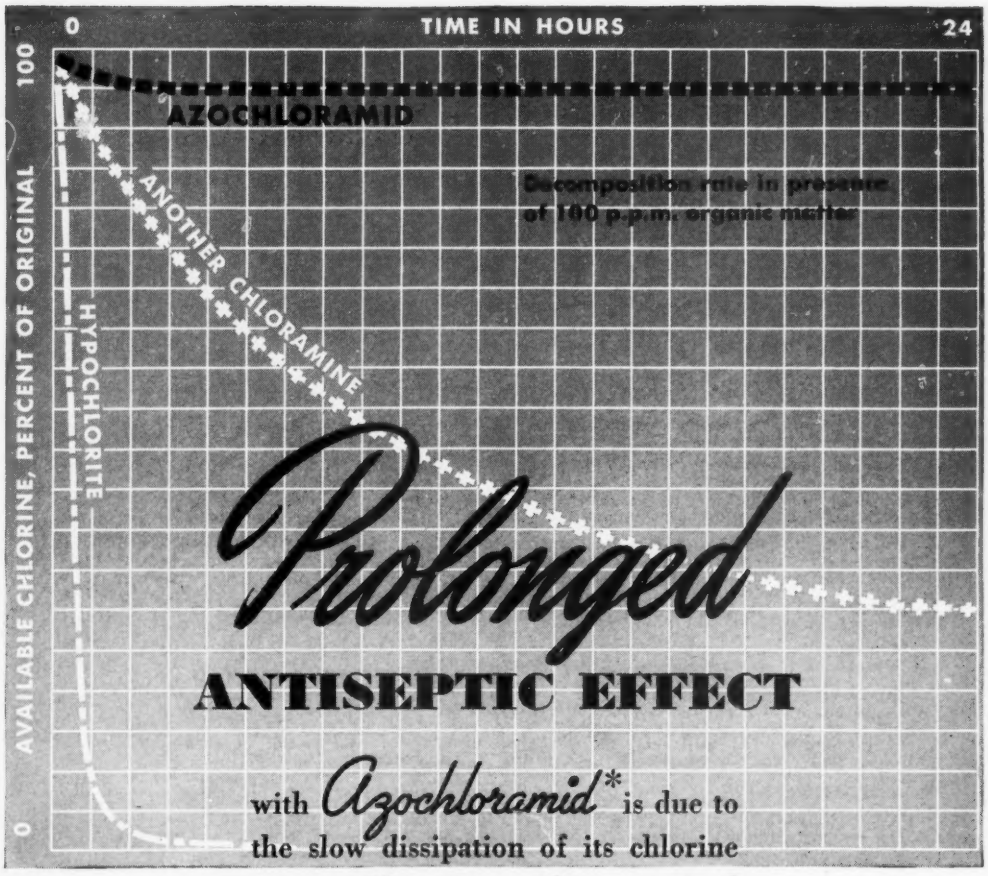
PHYSICAL FOUNDATIONS OF RADIOLOGY. By Otto Glasser Ph.D., Professor of Biophysics and Head of the Department of Biophysics, Cleveland Clinic Foundation, Cleveland, Ohio; Edith H. Quimby, Sc.D., Assistant Professor of Radiology, College of Physicians and Surgeons, Columbia University, New York; Lauriston S. Taylor, Ph.D., Chief of X-ray Section, National Bureau of Standards, Washington, D.C.; and J. L. Weatherwax, M.A., Philadelphia General Hospital and Graduate School of Medicine, University of Pennsylvania, Philadelphia. New York, 1944, Paul B. Hoeber, Inc.

MEDICAL RADIOGRAPHIC TECHNIQUE. Prepared by the Technical Service Department of General Electric X-ray Corporation under the editorial supervision of Glenn W. Files, Director. Cloth. Price $5.50. Pp. 365, with 381 illustrations. Springfield, Ill., 1943, Charles C Thomas, Publisher.

THE MODERN MANAGEMENT OF COLITIS. By J. Arnold Bargen, M.D., Chief of the Section on Intestinal Diseases, Mayo Clinic, Rochester. Cloth. Price $5.50. Pp. 322, with 148 illustrations, and 25 tables. Springfield, Ill., 1943, Charles C Thomas, Publisher.

THE YEAR BOOK OF GENERAL SURGERY FOR 1943. Edited by Evarts A. Graham, A.B., M.D., Washington University School of Medicine, St. Louis, Mo. Cloth. Price $3.00. Pp. 270, with 736 illustrations. Chicago, 1944, The Year Book Publishers, Inc.

TEXTBOOK OF GENERAL SURGERY. By Warren H. Cole, M.D., F.A.C.S., and Robert Elman, M.D. Cloth. Pp. 1118, with 559 illustrations. New York, 1944, D. Appleton-Century Company, Inc.



Prolonged
ANTISEPTIC EFFECT

with *Azochloramid** is due to the slow dissipation of its chlorine content. Thus, it provides a sustained antiseptic action—*reducing frequency of dressings (and accompanying trauma) and resulting in conservation of time on the part of medical attendants.*

*Trade Mark Reg. U. S. Pat. Off.

Azochloramid

Brand of Chloroazodin U.S.P.

W&T

For descriptive literature and sample write to
Wallace & Tiernan Products, Inc., P.O. Box 178, Newark 1, N. J.

ARMY E NAVY

WALLACE & TIERNAN
PRODUCTS, INCORPORATED
Belleville New Jersey

ACCEPTED AMERICAN MEDICAL ASSN.

SURGERY

Editors: ALTON OCHSNER, M.D., 1430 Tulane Ave., New Orleans, La., and OWEN H. WANGENSTEEN, M.D., University Hospitals, Minneapolis, Minn.

Associate Editor: ALFRED BLALOCK, M.D., Johns Hopkins Hospital, Baltimore, Md.

Published by THE C. V. MOSBY COMPANY, 3525 Pine Blvd., St. Louis (3), U.S.A.

Great Britain Agents: Henry Kimpton, Ltd., 26 Bloomsbury Way, London, W.C.1.
Entered at the Post Office at St. Louis, Mo., as Second-Class Matter.

Published Monthly. Subscriptions may begin at any time.

Editorial Communications

Original Communications.—This Journal invites concise original articles of new matter in the broad field of clinical and experimental surgery. Descriptions of new techniques and methods are welcomed. Articles are accepted for publication with the understanding that they are contributed solely to SURGERY.

Manuscripts submitted for publication may be sent to Dr. Alton Ochsner, 1430 Tulane Avenue, New Orleans, Louisiana, or to Dr. Owen H. Wangensteen, University Hospitals, Minneapolis, Minnesota.

Neither the editors nor the publishers accept responsibility for the views and statements of authors expressed in their communications.

Translations.—Manuscripts written in a foreign language, if found suitable for publication, will be translated without cost to the author.

Manuscripts.—Manuscripts should be typewritten on one side of the paper only, with double spacing and liberal margins. References should be placed at the end of the article and should conform to the style of the Quarterly Cumulative Index Medicus; viz., name of author, title of article, and name of periodical with volume, page, and year. Illustrations accompanying manuscripts should be numbered, provided with suitable legends, and marked on margin or back with the author's name.

Authors should indicate on the manuscript the approximate position of text figures. The original drawings, not photographs of them, should accompany the manuscript.

Illustrations.—A reasonable number of half-tone illustrations will be reproduced free of cost to the author, but special arrangements must be made with the editors for color plates, elaborate tables or extra illustrations. Copy for zinc cuts (such as pen drawings and charts) should be drawn and lettered only in India ink, or black typewriter ribbon (when the typewriter is used), as ordinary blue ink or colors will not reproduce. Only good photographic prints or drawings should be supplied for half-tone work.

Exchanges.—Contributions, letters, exchanges, reprints, and all other communications relating to SURGERY should be sent to one of the editors.

Review of Books.—Books and monographs, native and foreign, will be reviewed according to their merits and as space permits. Books may be sent to Dr. Owen H. Wangensteen, University Hospitals, Minneapolis, Minn.

Reprints.—Reprints of articles published among "Original Communications" must be ordered directly through the publishers, The C. V. Mosby Co., 3523 Pine Blvd., St. Louis (3), U. S. A., who will send their schedule of prices.

Business Communications

Business Communications.—All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3523 Pine Blvd., St. Louis (3), Mo.

Subscription Rates.—Single copies, 85 cents. To any place in the United States and its Possessions and the Pan-American Countries, $10.00 per year in advance. To Canada, $11.50 (Canadian Currency), and under foreign postage, $11.00. Includes two volumes a year, January and July.

Remittances.—Remittances for subscriptions should be made by check, draft, post office or express money order, or registered letter, payable to the publishers, The C. V. Mosby Co.

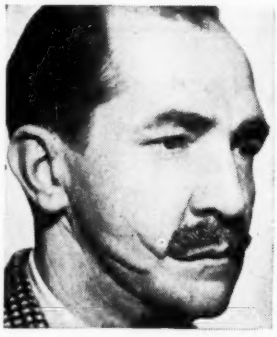
Change of Address.—The publishers should be advised of change of subscriber's address about fifteen days before the date of issue, with both new and old addresses given.

Nonreceipt of Copies.—Complaints for nonreceipt of copies or requests for extra numbers must be received on or before the 10th of the month preceding publication; otherwise the supply is likely to be exhausted.

Advertisements.—Only articles of known scientific value will be given space. Forms close tenth of month preceding date of issue. Advertising rates and page sizes on application.

I 22 DAYS

II 217 DAYS



III 566 DAYS

WAR-ADVANCED TREATMENTS OF MAXILLO-FACIAL INJURIES

From right angle of the mouth, an anti-tank shell wound extended into the cheek, upper lip and neck . . . severely lacerated the base of the tongue and fauces. Loss of skin was small. There was loss of the right side of mandible. (I)

After field care, patient was admitted to hospital where bone fragments were removed, fractured teeth extracted, wound trimmed, skin flaps sutured and Thiersch graft made. Twenty-two days later, upper and lower cap splints were inserted, permitting mastication.

After 217 days, Iliac bone graft (3½" long) was inserted. (II) And with 566 days of intermittent hospitalization, the patient returned to duty with: bony union; normal occlusion; full function; no serious impairment of appearance. (III)

This loss of tissue treatment is found in one of the many sections of "The Dental Treatment of Maxillo-Facial Injuries"—a profusely illustrated, thoroughly practical volume based on recent war experience.

Says the British *Dental Gazette:* " . . . on the treatment of facial and jaw injuries . . . none has given sounder instruction . . . it is a very excellent production, rational and lucid."

THE AUTHORS—a group of four outstanding, widely-known, Maxillo-Facial specialists of the East Grinstead Medical Center in Britain.

OUTSTANDING CONTENTS

- Discussion of types of Fractures
- Radiology
- Surgery of Soft and Hard Tissues including Loss of Tissue
- Technic
- Clinical Diagnosis
- Pathology of Bone Repair, including complications
- Reduction and Fixation
- Anesthesia

FIRST AMERICAN EDITION
THE DENTAL TREATMENT OF

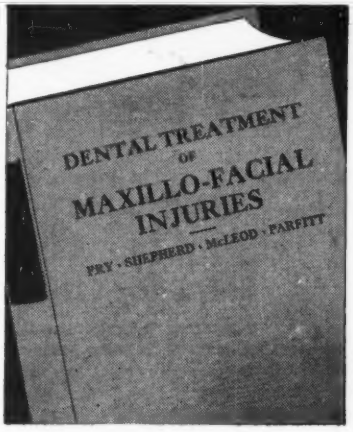
MAXILLO-FACIAL INJURIES

WITH SUPPLEMENTARY MATERIAL ON CASES AND TECHNIQUES

OVER 1000 ILLUSTRATIONS
18 IN FULL COLOR—988 IN BLACK AND WHITE

$6.50

A LIPPINCOTT SELECTED PROFESSIONAL BOOK



J. B. LIPPINCOTT COMPANY, Philadelphia 5, Pa.

Enter my order and send me "The Dental Treatment of Maxillo-Facial Injuries and Supplement", $6.50. Under your Guarantee I may return book in 10 days or I will pay in full in 30 days.

☐ Charge ☐ Cash Enclosed

SEND TO: NAME _____

STREET ADDRESS _____

CITY AND STATE _____ S-644

CANCER *of the* FACE *and* MOUTH

By **VILRAY P. BLAIR, M.D., SHERWOOD MOORE, M.D.,** and **LOUIS T. BYARS, M.D.,** St. Louis.

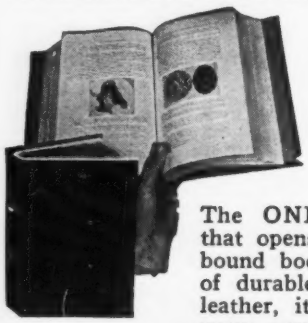
600 pages, profusely illustrated. **PRICE, cloth, $10.00.**

This volume is presented with the hope that a concise résumé of the observations made during the past twenty years on something over 1500 personally treated cases of epithelial malignancy arising in or about the face and mouth will be of some help, when help is most needed, to the men who first see these cases and who bear the great responsibility of deciding what shall be done at a time when it is most likely that something worth while can be done.

The volume is really a systematic review of the personal experience of the authors in the treatment of the cases discussed. The cases include those treated in the last twenty-five years, some by surgery alone, some by radiation alone, and some by a combination of radiation and surgery in close co-operation of the authors. The photographs were selected individually to demonstrate specific points of interest and each is discussed in the text. In addition there are zinc-lined etchings which clearly demonstrate points of technic.

THE C. V. MOSBY COMPANY—Publishers—St. Louis, Mo.

A Handsome Permanent Binder for SURGERY



ONLY $1.25

The ONLY binder that opens flat as a bound book! Made of durable imitation leather, it will preserve your journals permanently. Each cover holds 6 issues, one volume (2 volumes published each year). Do your own binding at home in a few minutes. Instructions easy to follow.

Mail coupon for full information and binder on 10-day free trial.

MAIL COUPON TODAY

SUCKERT LOOSE LEAF COVER CO.
234 W. Larned St., Detroit, Michigan

Mail postpaid _____ binders for "SURGERY" for year _____. Will remit in 10-days or return bindings collect.

Name _____

Address _____

FOR THE EXACTING GUEST

It's Baltimore's Best

—best for accommodations that provide a monopoly on luxury.
—best for location that places you in the principal downtown district, near business contacts and pleasure places.
—best for streamline service that offers you all the modern guest facilities.
—best because of these moderately priced public rooms—

MAIN DINING ROOM, NEW CHESAPEAKE LOUNGE, COFFEE SHOP

450 Large Guest Rooms

All rooms with bath, radio, and circulating ice water.

Single Rooms With Bath, $3.00 up
Double Rooms With Bath, $4.50 up

The Emerson HOTEL
BALTIMORE, MD. O.G. CLEMENTS, MGR.

Authoritative — Up-to-the-Minute — Complete

CURRENT OBSTETRICS AND GYNECOLOGY

Proceedings of the Second

AMERICAN CONGRESS ON OBSTETRICS AND GYNECOLOGY

A correlated program of essays, panel discussions and symposia epitomizing everything important and new in the fields of obstetrics and gynecology. The subject material, carefully integrated in advance, is presented under the strict criteria of question and answer discussions. Authors are unimpeachable authorities—each in his respective field. Discussors are especially selected for experience, critical ability. Analyses and summaries are—as a result—the last word. No stone is left unturned. The result is:

A Work Absolutely Essential to Specialist, General Practitioner, Nurse, Hospital Executive and Maternal and Child-Welfare Worker

Among the Contributors Are:

Fred L. Adair	Nicholson J. Eastman	Edward Allen
Aura E. Severinghaus	Herbert E. Schmitz	Robert D. Mussey
Robert Latou Dickinson	E. D. Plass	J. P. Greenhill
G. D. Royston	I. C. Rubin	E. G. Waters
Carl G. Hartman	Abner I. Weisman	Harry W. Mayes
R. S. Siddall	David S. Hillis	Alan F. Guttmacher
John L. Parks	Lewis C. Scheffey	Philip Levine
Alex E. Brown	A. W. Diddle	A. N. Arneson
E. Granville Crabtree	James R. Reinberger	Sidney O. Levinson
Curtis J. Lund	Lyman W. Mason	Paul F. Fletcher

and over sixty others

I *Almost every important teaching institution represented.*

II *Obstetrics, Gynecology, Obstetrical Hospital Management, Obstetrical Nursing, Public Health and Social Service Aspects.*

III *A complete correlated refresher course absolutely up to date.*

Price, $5.50

PUBLISHED BY THE WESTERN JOURNAL OF SURGERY PUBLISHING COMPANY, PORTLAND, OREGON, FOR THE AMERICAN CONGRESS ON OBSTETRICS AND GYNECOLOGY

To: 6-44

THE AMERICAN CONGRESS ON OBSTETRICS AND GYNECOLOGY
650 Rush Street
Chicago, Illinois

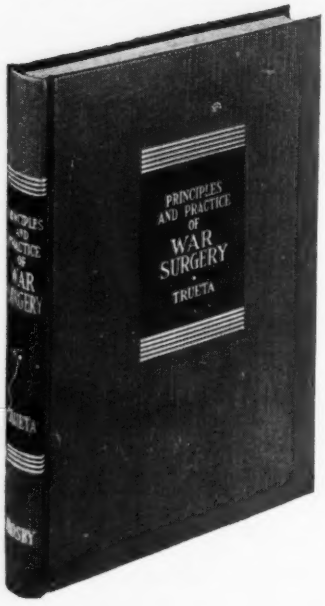
Please place my order for one copy of the 1942 Transactions, at $5.50 per volume, for which check is enclosed (or) you may bill me when volume is shipped.

Name _____ M.D.

Address _____ City _____ State _____

PRINCIPLES AND PRACTICE OF

WAR SURGERY



by J. TRUETA, M.D.

Formerly Director of Surgery, General Hospital of Catalonia, University of Barcelona; Assistant Surgeon (E.M.S.) Wingfield-Morris Orthopaedic Hospital; Acting Surgeon-in-Charge, Accident Service, Radcliffe Infirmary, Oxford. 425 pages, 144 illustrations. PRICE, $6.50.

5-Point TRUETA *Technic*

1. **Prompt surgical treatment.**
2. **Cleansing of the wound.**
3. **Excision of the wound.**
4. **Provision of drainage.**
5. **Immobilization in a plaster-of-Paris cast.**

Listed above are the five essential principles in the biological treatment of wounds as formulated by Trueta, each and every one of which must be applied to ensure the greatest possible success.

In this new book "PRINCIPLES AND PRACTICE OF WAR SURGERY," Trueta sets forth in complete detail these procedures which he has adopted as a result of his experience in the Spanish War and in World War II. However the book is not confined to these methods alone, but deals fully with such important subjects as shock, transfusion, aerobic and anaerobic infections, including gas gangrene and tetanus, chemotherapy, antiseptics, anesthesia, skin grafting, amputation, and treatment of burns.

Graphic illustrations such as those reproduced here supplement the text matter, supplying step-by-step visual guidance. You won't want to miss having this authoritative text. Send for it today!

The C. V. Mosby Company MJ
3525 Pine Blvd., St. Louis 3, Mo.

Gentlemen: Send me a copy of Trueta—Principles and Practice of War Surgery. Price, $6.50.

____Attached is my check. ____Charge my account.

Dr. _____

Address _____

Get These Famous Bailey Books

Bailey—SURGERY OF MODERN WARFARE

Edited by **Hamilton Bailey**, F.R.C.S., Royal Northern Hospital, London, with 77 authoritative contributors. Third 1944 edition, two volumes, each over 500 pages, each about 450 illustrations, many in color, $20.00 per set. Not sold separately. Vol. 1 now ready. Vol. 2 in two months. Order by set.

The first two editions of this great timely book of actual wartime surgical practice have been of immense help to the medical services of the allied nations and particularly in orienting newly recruited civilian physicians and surgeons to war conditions and methods. Over 10,000 sets of the work are in use and the demand, military and civilian, has continually exceeded the supply. Even the War Department was unable to get all the copies desired. In spite of increasing difficulties Mr. Hamilton Bailey and his valiant band of seventy-six contributors have again combined their knowledge and experience to produce a thoroughly revised third edition. The work is again brought up-to-date with more recent experience, knowledge gained and successful methods developed in the present war. The editor has had particularly good cooperation from the Medical Director-General of the Royal Navy and the Director-General of the Royal Air Force Medical Services. As before, the work is confined to a clear concise presentation of practical usable information with everything made clearer and thousands of words saved, by the very large number of excellent illustrations, many new with this edition, including very fine color photographs.

The Journal A. M. A. said: "It will prove of great value to military surgeons throughout the world, and especially to those in America who are just entering on their military service."

Surgery, Gynecology and Obstetrics said: "They will be of unquestioned value to the surgeon faced with the problem of treating the wounded."

The Military Surgeon said: "They are a multum in parvo and save time and space by taking the place of numbers of monographs. All surgeons who are dealing with war and war conditions should have access to both these volumes."

U. S. Naval Medical Bulletin said: "This book is a 'must' for every surgeon entering the military service for it presents surgical problems in a light vastly different from that encountered in civil practice."

Bailey—PHYSICAL SIGNS IN CLINICAL SURGERY

By **Hamilton Bailey**, F.R.C.S., Surgeon, Royal Northern Hospital, London. Ninth (1944) edition, 359 pages, 492 illustrations, many colored, $7.00.

The very great popularity of this unique book continues to increase with practitioners, teachers of surgical diagnosis, and students. To see a copy means an instantaneous desire to possess it. The practical value is so obvious. The nearly 500 beautiful illustrations speak for themselves. The descriptions are concise but wonderfully clear. It is doubtful if any other book of its size has ever done so much to promote speed and accuracy in surgical diagnosis. For the beginner it is a Godsend, and experienced practitioners find it an inspiring refresher. Military surgeons, accustomed mostly to civilian medical practice, will find this book helpful. Thorough knowledge of physical signs is a great asset under front-line conditions, when diagnosis must often be immediate, with no time for laboratory or X-ray confirmation. The new ninth edition shows many improvements in text and illustrations, without drastic changes. It does not pretend to be a complete work on surgical diagnosis but you will like it immensely.

Bailey—EMERGENCY SURGERY

By **Hamilton Bailey**, F.R.C.S., Surgeon, Royal Northern Hospital, London. Fifth edition, 1944, 977 pages, 1039 illustrations, many colored, $18.00.

Back in 1927 the first edition of Bailey—Physical Signs was a revelation to American surgeons, especially teachers. Obviously Mr. Hamilton Bailey was that rare combination, a brilliant surgeon who knew how to convey his professional knowledge and experience to others in an unusually effective clear and attractive manner, relying on super-excellent illustrations even more than beautifully written text.

A strong demand arose for "more Bailey" especially surgical methods and technique. Inspired by the "surgical bible" of his earlier days, "Lejars—Urgent Surgery," Mr. Bailey had interrupted his successful surgical career to go back as resident surgical officer of a large municipal hospital in the great industrial city of Birmingham, to gain more experience of emergency surgery while writing a long planned book on that subject. That task took over four years but the book was an immediate success. The new fifth edition has been quite thoroughly revised, many chapters have been virtually rewritten, and many of the twice bombed out illustrations very successfully replaced. This book was written for the emergencies of civilian surgeons, but some lessons from war experience have been incorporated and the value of most of the volume to military surgeons will be obvious.

THE WILLIAMS & WILKINS COMPANY Publishers of William Wood Books BALTIMORE 2, MD.

Nurses Are Needed Now!

FOR SERVICE IN THE

ARMY NURSE CORPS

IF YOU ARE A REGISTERED NURSE AND NOT YET 45 YEARS OF AGE APPLY TO THE SURGEON GENERAL, UNITED STATES ARMY, WASHINGTON 25, D. C., OR TO ANY RED CROSS PROCUREMENT OFFICE

RPB

covering surgical problems which arise in everyday urological practice . . .

AUSTIN I. DODSON'S

UROLOGICAL SURGERY

By **AUSTIN I. DODSON, M.D., F.A.C.S.**

Professor of Urology, Medical College of Virginia; Urologist to the Hospital Division, Medical College of Virginia.

With Contributions by

R. A. BERGER, M.D., DOUGLAS G. CHAPMAN, M.D., EVERETT IDRIS EVANS, Ph.D., M.D., FRED M. HODGES, M.D., MAJOR GUY WINSTON HORSLEY, LINWOOD D. KEYSER, M.D., LAWRENCE O. SNEAD, M.D., F.A.C.R.

750 pages, 576 illustrations.

PRICE, about $10.00. READY JUNE 15th!

Urologist, surgeon and general practitioner will find valuable assistance in this latest contribution of a recognized authority in the field. In UROLOGICAL SURGERY, Dr. Dodson has created a clinical aid as well as a supplement to the ordinary text in urology.

Although primarily concerned with surgery, in order to give the non-specialist background material, the text includes urological diagnosis and pathology.

Operative procedures are illustrated by Helen Lorraine. Dr. Dodson describes one or more procedures for each surgical problem. They are methods which in his vast experience he has found practical or has determined physiologically sound.

THE C. V. MOSBY COMPANY MJ
3525 Pine Blvd., St. Louis 3, Mo.

Gentlemen: Send me a copy of Dodson's UROLOGICAL SURGERY, as soon as it comes from the press. The price will be about $10.00.

☐ Attached is my check. ☐ Charge my account

Dr. _____

Address _____

This American is *not* expected to buy an extra War Bond in the 5TH WAR LOAN

But we are.

For each of us here at home, the job now is to buy extra Bonds—100, 200, even 500 dollars worth if possible.

Many of us can do much more than we ever have before.

When the Victory Volunteer comes to you and asks you to buy extra Bonds, think how much you'd give to have this War over and done.

Then remember that you're not *giving* anything. You're simply *lending* money—putting it in the best investment in the world.

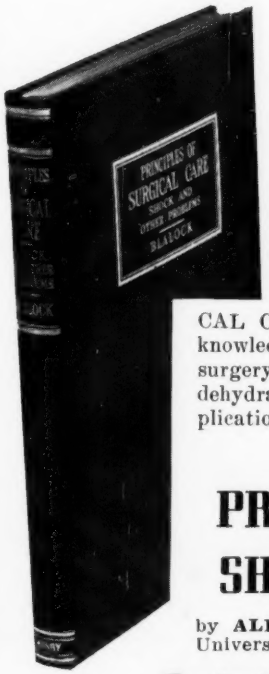
5TH WAR LOAN

Let's Go . . . for the Knockout Blow!

The C. V. MOSBY COMPANY, Medical Publishers—St. Louis 3, Mo.

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

Make Your Surgical Patient SAFE for Operation



Surgery means more than cutting tissue or tying blood vessels. The modern concept of surgery is safety for your patient—the prevention of shock and the proper treatment of shock if it should develop. It means a proper understanding of peripheral circulation, water balance, the oxygen supply to the tissues. It means a proper understanding of chemistry of the body fluids and of how to maintain the proper electrolyte balance in the body fluids.

As a competent surgeon you must have a thorough knowledge of these principles. Blalock's "PRINCIPLES OF SURGICAL CARE: SHOCK AND OTHER PROBLEMS" gives you this knowledge clearly, simply and completely. The work of a pioneer in surgery, it covers not only shock but also such related problems as dehydration, hypoproteinemia, avitaminosis, anoxia, pulmonary complications and intestinal distention.

PRINCIPLES *of* SURGICAL CARE SHOCK AND OTHER PROBLEMS

by **ALFRED BLALOCK, M.D.**, Professor of Surgery, Johns Hopkins University. 308 pages, 13 illustrations. PRICE, $4.50.

Contents

Introduction; Anesthesia and Anesthetic Agents; Surgical Technique and the Treatment of Wounds; Disorders of the Circulatory System: Heart Diseases; Disorders of the Circulatory System: Thrombosis and Embolism; Disorders of the Circulatory System: Shock or Peripheral Circulatory Failure; Metabolic and Nutritional Disturbances: Fluid and Electrolyte Disorders; Metabolic and Nutritional Disturbances: Acid-base Disorders; Metabolic and Nutritional Disturbances: Nutritional Disorders of Surgical Patients; Metabolic and Nutritional Disturbances: The Management of the Surgical Patient with Diabetes; Metabolic and Nutritional Disturbances: Hypertension and Nephritis in Surgical Patients; Metabolic and Nutritional Disturbances: Endocrine Disorders; Postoperative Pulmonary Complications; Abdominal Complications; Other Complications.

Reviews

"It emphasizes that operation is only part of the treatment of surgical patients. The author has presented well correlated and well digested material. The book is an enlightening report of the care a modern surgeon can offer along with his skillful technic and judgment at the operating table." JOURNAL OF THE A. M. A.

"Here is a book which should not only be in the library of every physician and surgeon, but its contents should become as much a part of them as their knowledge of Gray's Anatomy and Osler's Medicine." ANNALS OF SURGERY.

"There is probably no one so well equipped to write a monograph on shock as is Blalock, and he has lived up to expectations in presenting a book which every student and every practitioner of medicine should have." SURGERY.

THE C. V. MOSBY COMPANY MJ
3525 Pine Blvd., St. Louis 3, Mo.

Gentlemen: Send me Blalock's "PRINCIPLES OF SURGICAL CARE: SHOCK AND OTHER PROBLEMS," price, $4.50. ____Attached is my check. ____Charge my account.

Dr. _____

Address _____

INDEX TO ADVERTISERS

Please mention "SURGERY" when writing to our advertisers—It identifies you

American Congress on Obstetrics and Gynecology (Proceedings) ------ 15
Army Nurse Corps---------- 18
Articles to Appear in Early Issues--
----------3rd Cover

Bard-Parker Company, Inc. (Rib-Back Blades) ---------- 3

Ciba Pharmaceutical Products, Inc. (Lipoiodine Tablets) ---------- 7

Davis & Geck, Inc. (Catgut)------- 2

Emerson Hotel, The (Baltimore, Md.) 14
Ethicon Suture Laboratories (Sutures)----Insert between pp. 8 and 9

5th War Loan---------- 20

Gilmer Binder, The (Journal Binder) 22

Hoffmann-La Roche, Inc. (Pantopon)
----------4th Cover

Iodine Educational Bureau, Inc. (Iodine) ---------- 6

Journal of Bone and Joint Surgery, The ---------- 6

Lilly and Company, Eli (Penicillin) 10
Lippincott Company, J. B. (Surgical Books) ---------- 13

O'Leary, Inc., Lydia (Covermark)-- 8

Singer Sewing Machine Company (Surgical Stitching Instrument)--- 9
Sklar Manufacturing Company, The J. (Surgical Instruments)-------- 1
Stearns & Company, Frederick (Parenamine Amino Acids)--------4, 5
Suckert Loose Leaf Cover Co. (Journal Binder) ---------- 14

Wallace & Tiernan Products, Inc. (Azochloramid) ---------- 11
Williams & Wilkins Company, The (Surgical Books) ---------- 17

All possible care is exercised in the preparation of this index. The publishers are not responsible for any errors or omissions.

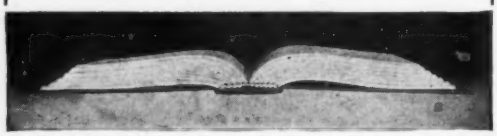
Make a Real REFERENCE BOOK OF YOUR JOURNAL

File each copy as soon as received so it will be instantly available when you want to refer to a recent article. We have secured what we believe to be the best binder made for this purpose. It is light, easy to operate, and handsome, and opens perfectly flat for easy reference.

Binder to hold 1 volume (6 issues) PRICE, $2.00

Binder to hold 2 volumes (12 issues—1 year) PRICE, $2.50

(Specify one you wish sent)



PRODUCED BY GILMER

Individual name or date and volume number will be stamped in gold on back of each binder for 50c. Sent postpaid on receipt of check or money order, with a guarantee that if you are not more than satisfied, your money will be refunded.

Be sure to state that the binder is intended for use with this journal.

Address The Gilmer Binder
307 New Street, Philadelphia, Pa.

ALEXANDER'S *New* OPERATING ROOM TECHNIQUE

By EDYTHE LOUISE ALEXANDER, R. N. Graduate of New York Training School; Supervisor of the Operating Rooms of the Roosevelt Hospital, New York. 392 pages, 220 illustrations. Price, $3.75.

CONTENTS—General Arrangement of Department. Care and Cleaning of Operating Room. Personnel of Operating Room. History of Asepsis. Sterilization. Cleansing of Skin. Care and Sterilization of Equipment. Suture Material. Duties of Nurse in Anesthesia Room. Standardization of Duties During Operative Schedule. Positions. Preparation of Skin. Instruments and Needles. Throat and Neck Operations. Chest Operations. Abdominal Wall. Stomach Operations. Small Intestine. Gallbladder and Bile Duct. Large Intestine. Lower Sigmoid, Rectum and Anal Region. Spleen and Kidney. Vaginal Gynecological Operations. Abdominal Gynecological Operations. Urology. Orthopedic Surgery. Neurosurgery. Vascular Operations.

The C. V. Mosby Co. — Publishers
St. Louis, Mo.

Articles to appear in early issues of

SURGERY

Symposium on Endocrinology of Neoplastic Diseases

MYOBLASTOMA.
By Chester W. Howe, M.D., Boston, Mass., and Lieutenant Commander Shields Warren, Medical Corps, U.S.N.R.

EXPERIMENTAL OBSERVATIONS ON THE HUMAN ILEOCECAL VALVE.
By Captain Raymond E. Buirge, Medical Corps, Army U. S.

THE STORY OF THE KENNY METHOD.
Released by The National Foundation for Infantile Paralysis, Inc., New York, N. Y.

MALIGNANT PAPILLARY CYSTADENOMA OF SWEAT GLANDS WITH METASTASES TO THE REGIONAL LYMPH NODES.
By Robert C. Horn, Jr., M.D., Philadelphia, Pa.

SPOOL COTTON AS SUTURE MATERIAL.
By Joe R. Floyd, Lt. Col., M.C., and Mark J. Brockbank, Capt., M.C., U. S. Army.

THE EFFECT OF SEX HORMONES ON SKELETAL METASTASES FROM BREAST CANCER.
By Joseph H. Farrow, M.D., New York, N. Y.

THE ENDOCRINE EFFECTS OF PITUITARY TUMORS.
By William J. German, M.D., New Haven, Conn.

HYPERINSULINISM IN RELATION TO PANCREATIC TUMORS.
By Allen O. Whipple, M.D., New York, N. Y.

HORMONAL TUMORS OF THE ADRENAL.
By George F. Cahill, New York, N. Y.

ENDOCRINE FACTORS IN THE ORIGIN OF TUMORS OF THE UTERUS.
By Howard C. Taylor, Jr., New York, N. Y.

ADRENAL CORTICAL TUMORS—PHYSIOLOGIC CONSIDERATIONS.
By Allan T. Kenyon, M.D., Chicago, Ill.

THE ENDOCRINOLOGIC ASPECTS OF TUMORS OF THE PINEAL GLAND.
By Leo M. Davidoff, M.D., F.A.C.S., Brooklyn, N. Y.

THE ENDOCRINE ASPECT OF ENLARGEMENTS OF THE PARATHYROID GLANDS.
By Oliver Cope, M.D., Boston, Mass.

THE ENDOCRINE TREATMENT OF CANCERS OF THE PROSTATE GLAND.
By Archie L. Dean, Helen Q. Woodard, and Gray H. Twombly, New York, N. Y.

THE RELATIONSHIP OF HORMONES TO DISEASES OF THE BREAST.
By Ira T. Nathanson, M.S., M.D., Boston, Mass.

TUMORS IN EXPERIMENTAL ANIMALS RECEIVING STEROID HORMONES.
By W. U. Gardner, Ph.D., New Haven, Conn.

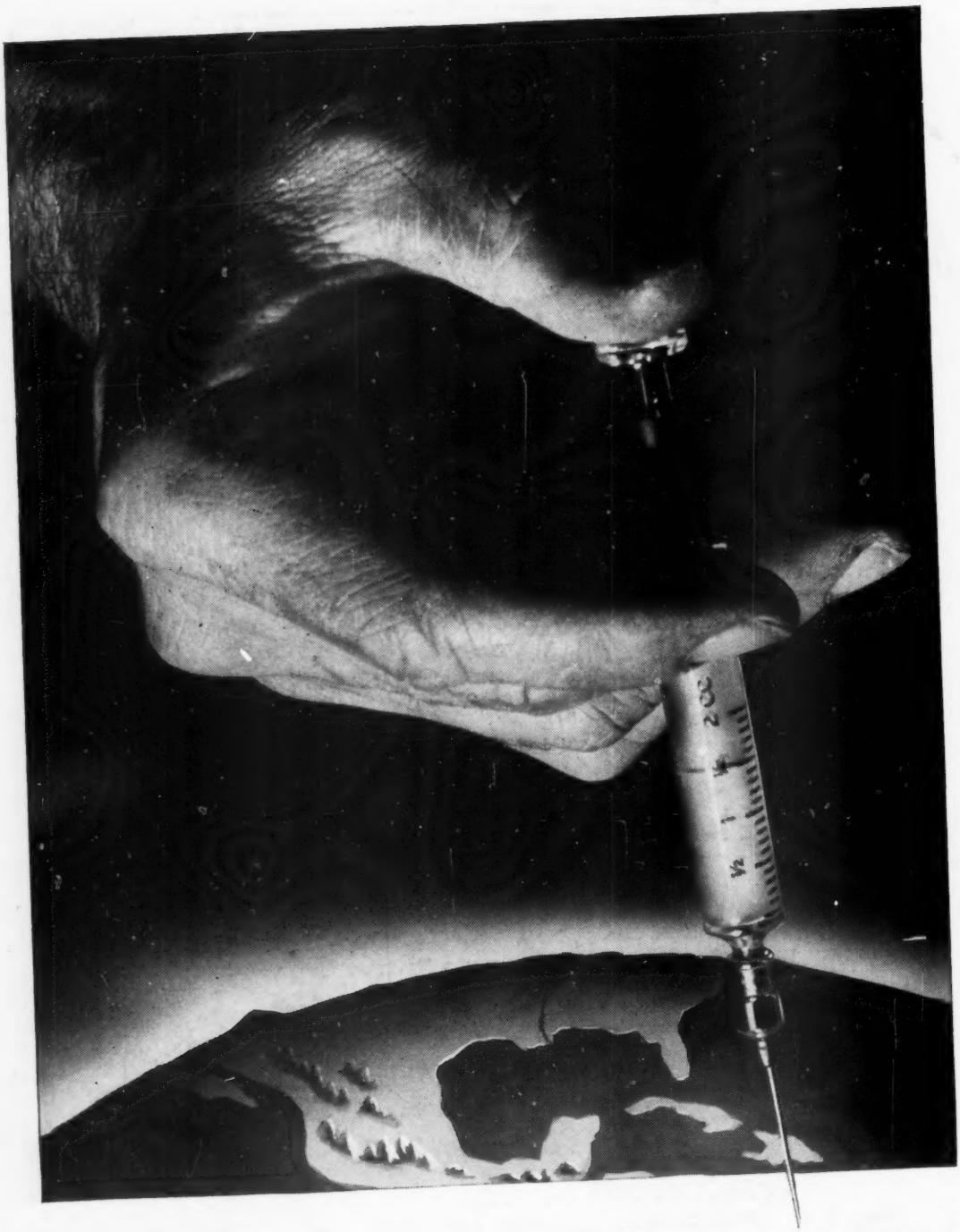
BENIGN HYPERTROPHY AND CARCINOMA OF THE PROSTATE. OCCURRENCE AND EXPERIMENTAL PRODUCTION IN ANIMALS.
By Robert A. Moore, M.D., St. Louis, Mo.

OVARIAN TUMORS WITH SEX HORMONE FUNCTION.
By Emil Novak, M.D., Baltimore, Md.

EXPERIMENTAL INVESTIGATIONS CONCERNING THE ROLE OF THE PITUITARY IN TUMORIGENESIS.
By Hans Selye, M.D., Ph.D., D.Sc., F.R.S.(C), Montreal, Quebec.

THE ENDOCRINE ACTIVITY OF THYROID TUMORS AND THE INFLUENCE OF THE THYROID HORMONE ON TUMORS IN GENERAL.
By Jacob Lerman, M.D., Boston, Mass.

THE RELATIONSHIP OF HORMONES TO TESTICULAR TUMORS.
By Gray H. Twombly, M.D., New York, N. Y.



CONQUEST OF PAIN . . . PANTOPON 'ROCHE'

DEC -6 1945